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WONDERS
OF ANIMAL LIFE

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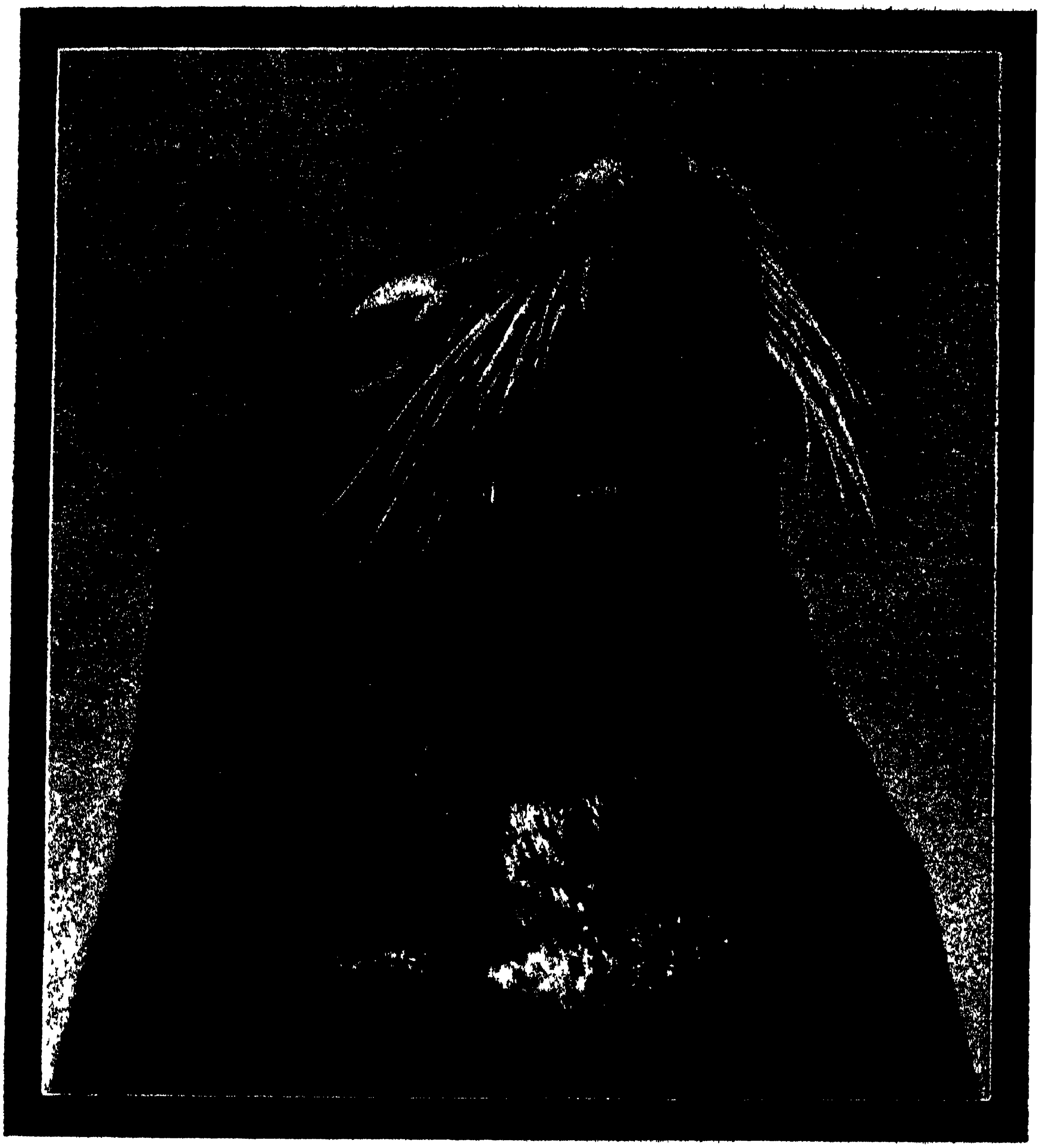

WONDERS OF ANIMAL LIFE

By Famous Writers on Natural History

Edited by
J. A. HAMMERTON

Over Three Thousand Illustrations from Photographs
and Thirty-three Colour Plates

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Chapter LXXXII

Nature's Busy Miners and Tunnellers

By W. Percival Westell

Author of "The Book of Nature"

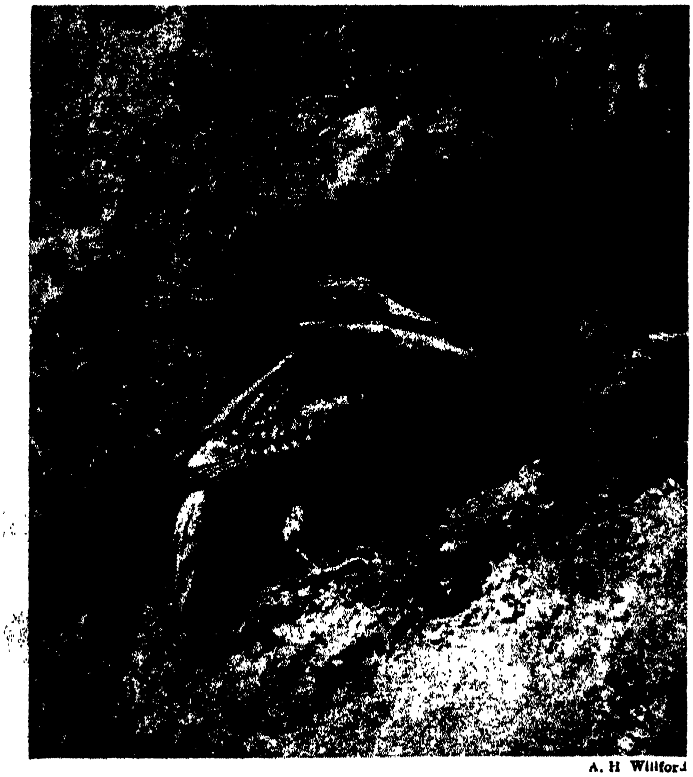
So many of the inhabitants of the busy world of animal life work unheard and unseen that the ordinary observer has little, if any, conception of the marvels and mysteries that encompass us. Even the skylark that soars and sings well within sight is rarely seen performing its domestic duties, its apology for a nest being hidden among summer's wealth of grasses. Bees and butterflies may be watched at close quarters during their sweet pillage among the flowers—gay buccaneers as many of them are—but few have any idea of their life histories, and of how the perfect insect came into being. Only the Nature student gets behind the curtain, or has a peep behind the scenes.

If, then, it is only possible to get fleeting glances, as it were, of Nature's children who share with ourselves the glorious heritage of Mother Earth, what shall be said of the army of miners and tunnellers who work and play out of sight and hearing? A wasp may be seen rasping from a fence, post, or gate a tiny strip of wood wherewith to commence or enlarge its nest, but no human eye is able to watch the creature underground, the entrance to whose home is just a small hole in a bank. Tree wasps and their fellows can be watched at their operations. One tree wasps' nest that came under my own observation was suspended in a gooseberry bush and resembled a grey Chinese lantern deftly hung among the ripening berries, but the wasps that place their citadels underground are subterranean workers the result of whose labour is only observable when the finished product is extracted for us.

Some of these navvies work desperately hard to attain their ends, others adopt the method of "slow but sure." Some work only at night, irrespective of the fact that their holes, or burrows, are in the dark. Some of the holes or tunnels that are made are merely used for one season and are then deserted. On the other hand, certain animals, such as badgers and foxes, resort to the same underground dwelling for many years, enlarging or altering as occasion and circumstances demand. A deserted or even tenanted hole made by one kind of animal is often eagerly taken possession of by another. The kingfisher, for example, will frequently commandeer the tunnel made in a river bank by the trim and elegant water vole, and at the extremity of the tunnel this bright-clad bird and expert fisherman places its pure glossy-white eggs. Once having obtained possession of the tunnel, the kingfisher continues a tenant by right of occupancy, and the water vole must, of necessity, set to work to make a fresh retreat.

The holes made by the water vole—known by sight to anglers in our sluggish waterways—are not used for rearing the young. They are bolt holes, or hiding-places, into which the animal can escape from its enemies. The nest, a globular homestead about the size of a football, is composed of dry grasses and other materials, and is placed among aquatic herbage, as a rule well out of harm's way.

The prairie marmot is an inhabitant of the dry, desert regions and open plains of the Rocky Mountain plateau. Another species is found in Mexico. One species, the Columbian prairie marmot, is more of a mountain dweller than its cousin of the lower regions. These are social dwellers, and the common species takes possession of many acres of country and riddles it with burrows. Each burrow is tenanted by several animals. There is a funnel-shaped entrance made of earth thrown out of the burrow, and this forms a look-out place. When danger threatens these little prairie


A. H Willford

KINGFISHER AND THE TUNNEL IT MADE

Cautious observers may track the kingfisher to its nesting place and will find that the young are reared at the end of a tunnel in the river bank. Often the burrow of a vole or "water-rat" is utilised, but otherwise the bird is very well able to make its own tunnel.

F. Vear

YOUNG RABBITS UNEARTHED AT THE END OF THEIR UNDERGROUND HOME

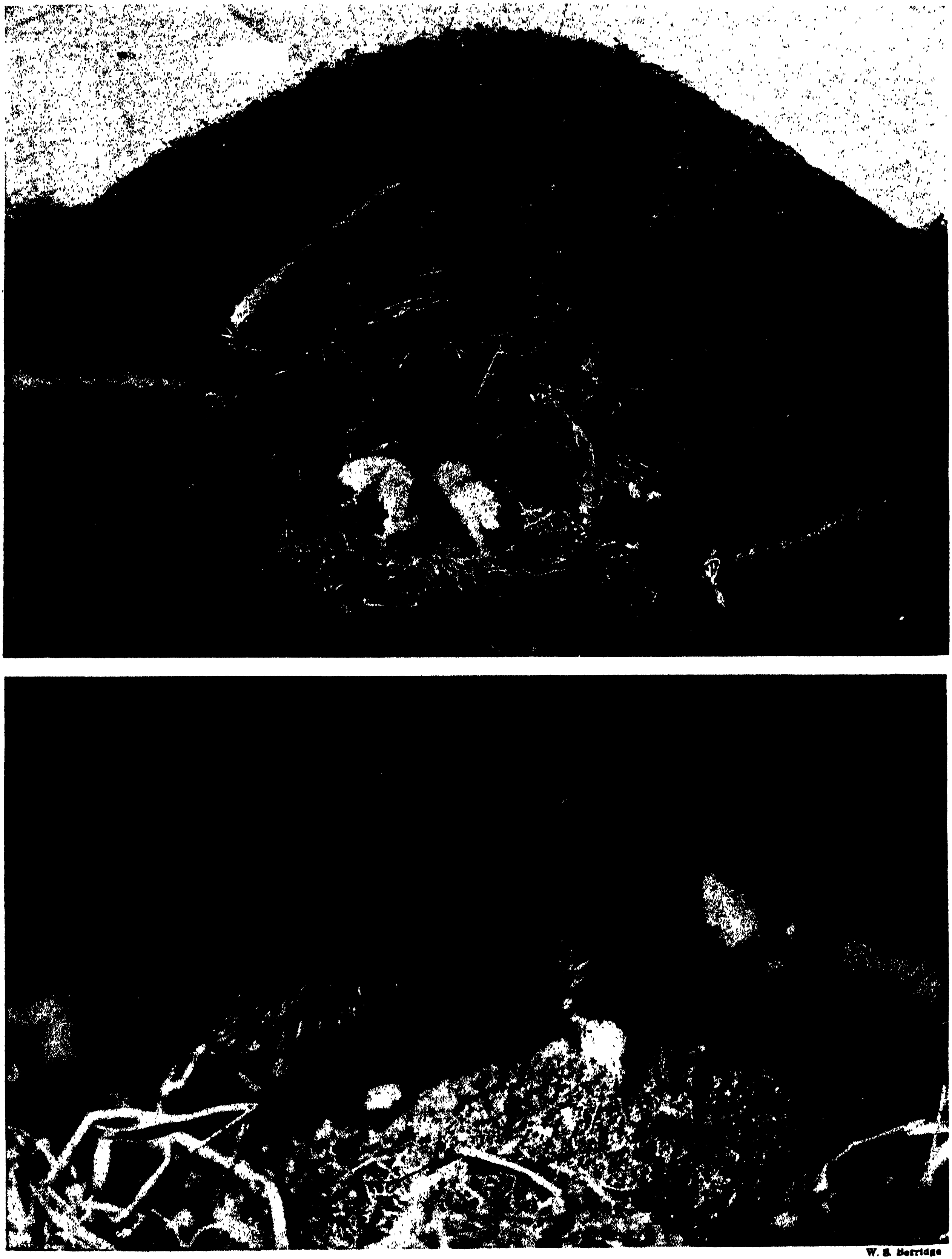
Sharp steel spades, wielded lustily, have discovered the precious secret that the mother rabbit hoped the earth would keep. The family of young rabbits in their nursery at the end of a long burrow has been brought to the unwanted light of day for the purpose of photography. The warren where it lives has tunnels which ramify something like those of a coal mine and these tunnels are altered and adapted to changing conditions from time to time according to the fortune of the warren.

folk utter a shrill whistling sound, whereupon all within hearing of the danger signal disappear very rapidly underground.

With four-footed animals, such as the badger, fox, marmot, mole, rabbit, and others the navvying is done with the feet, and it is astonishing at what a rate the excavating is accomplished and the distance soil has to be moved where the tenant makes passages far underground. Rabbits, as all country dwellers know, are expert diggers. Their warrens, in districts where these rodents abound and where the soil is easily worked, are a familiar sight in rural England, and a great many inhabitants are found in one community. Early morning and late evening are favourite times for Brer Rabbit to steal warily from his hiding-place beneath the soil, to feed. The rabbit nibbles grass and other herbage when the dew is upon it, and is more fond of drinking than is generally supposed. It depends for protection on its fleetness of foot and its invariable habit of skulking in the undergrowth, if its underground dwelling cannot be reached. The white upturned tail serves as a warning to its fellows. The young are nearly always born underground and are blind, naked, and helpless for several days. Where a rabbit warren is well established it is used by succeeding generations, and is a happy hunting-ground for fox, stoat and weasel. The former, however, rarely seeks his prey close at home, for I have seen Reynard pass, unheeded, whole companies of rabbits not far from his very own " earth."

Fox and badger sometimes share the same abode, but it is not a good arrangement for Brock, the badger, as he is clean and tidy in his home affairs, whereas Reynard has yet to learn the ethics of good housekeeping. An old haunt of the badger will be tenanted over a period of many years, and in course of time, as new apartments are made and débris is brought to the surface, huge mounds of earth are accumulated. Trees of large dimensions spread their tapering roots below ground and among these the hidden ramifications of the nocturnal wanderer's home are situated.

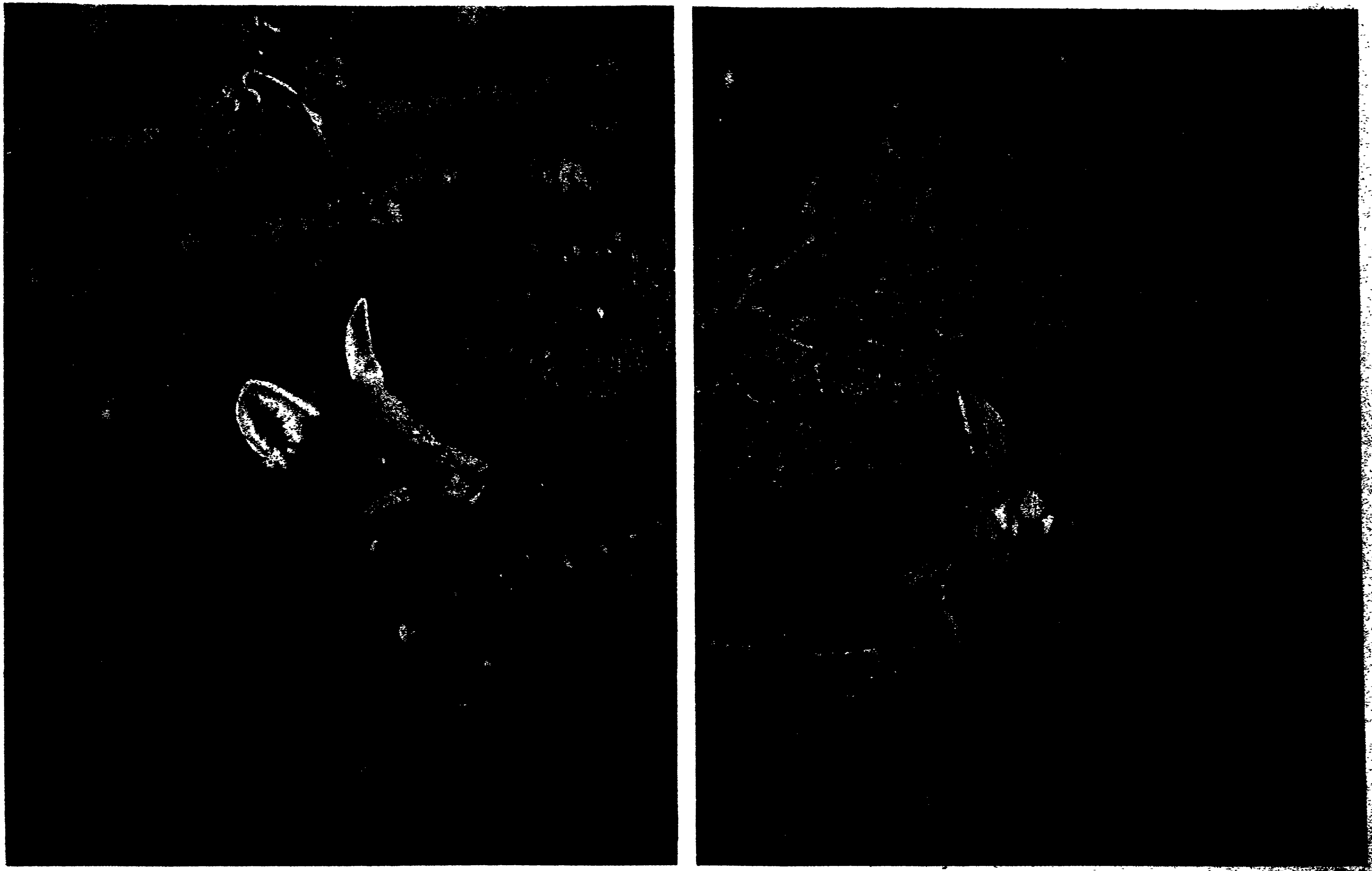
The brown rat, and that happy-go-lucky little fellow, the wood mouse, are both burrowers, but the velvet-clad mole is one of our most industrious, if somewhat destructive, tunnellers. It is partial to damp meadows and pastures where, when the miner has been busy during the night-watch, many hillocks



W. S. Berridge

GOLDEN MOLE AND A SECTION THROUGH A MOLE-HILL

Distinguished by its beautiful coat the golden mole (bottom) has the same habits as its relatives save that the tunnelling operations which it undertakes are not betrayed at a few places by mole-hills but throughout their entire length by reason of their being dug only just below the surface. Thus their presence is shown by the ridges in the turf which are the roofs of the tunnels. A careful section through the "hill" of a common British mole (top) reveals the nature of this busy little miner's home and nursery.



"THE FOX FROM HIS LAIR IN THE MORNING": YOUNG REYNARD COMES ABOVE GROUND

Foxes are by no means the most energetic or enterprising of Nature's miners and tunnellers for they like some other animal to do as much of the work of making the underground home as possible. The fox's earth is usually in the burrow of a rabbit or a badger, and this the little red raider adapts for his own purposes. But sometimes Reynard digs his own earth. In the summer time, however, a dry ditch often serves as a sleeping place, while hollow trees and clefts in rocks are freely used, for, of course, such a bundle of craft and cunning is an opportunist of the first order. These photographs were taken in the Welsh mountains and show a young fox preparing to leave his earth but looking cautiously round first.

A. Brook

SUNSET DISCOVERS SOME FOX CUBS PLAYING ROUND THEIR EARTH

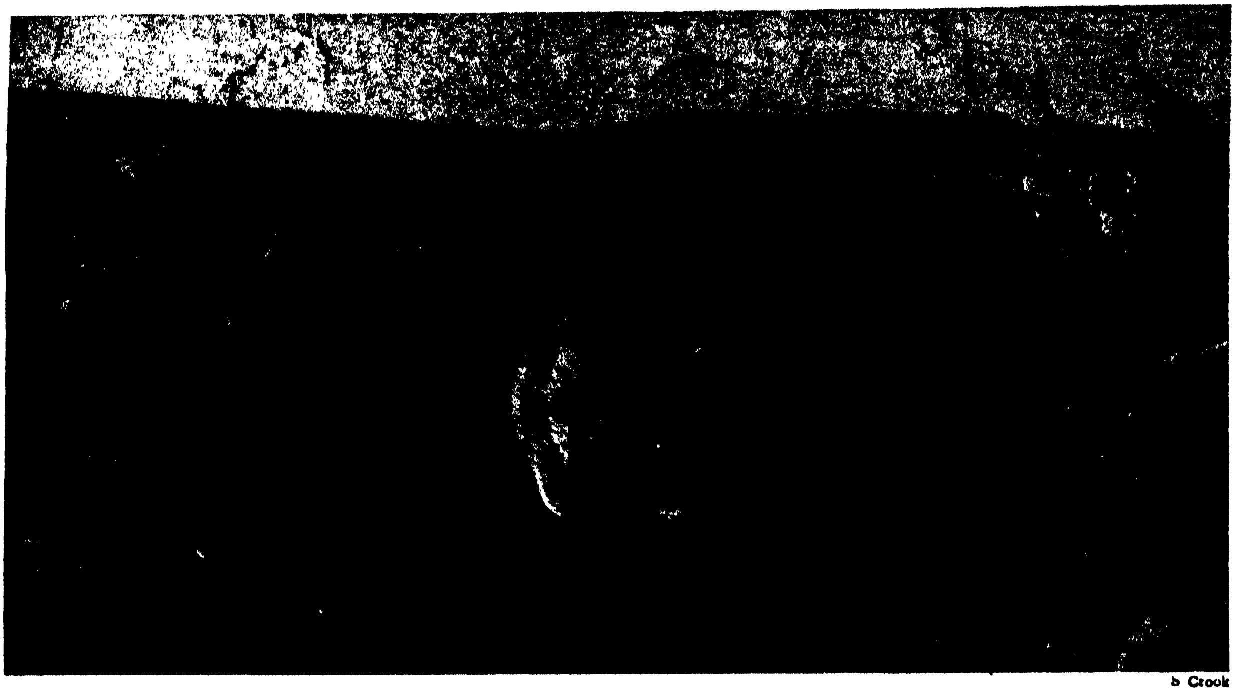
After sunset it is that the fox cubs come up out of the dark where they have spent the day to play in the twilight which, ever becoming deeper, emboldens them with the nearness of the night when all foxes can go fearlessly into the open. At the moment of the photograph the light was still good and the cubs, therefore, did not care to go more than a few jumps distant from the mouth of their earth. This is dug in the bank which divides two fields and is directly under the wire of a fence.

of soil spell industry. The pointed head of the mole, its rounded body, soft fur, and fine digging forelegs armed with strong, sharp nails, are admirably suited for the life it leads, and though it can move fairly quickly above ground, its movements beneath the soil are prodigious. When one remembers that this creature of the wild has to force its way through the ground and often has no time to clear a passage as it goes, its progress is little short of miraculous, as those who have disturbed a specimen on the surface and watched it disappear as if by magic, will be able to testify.

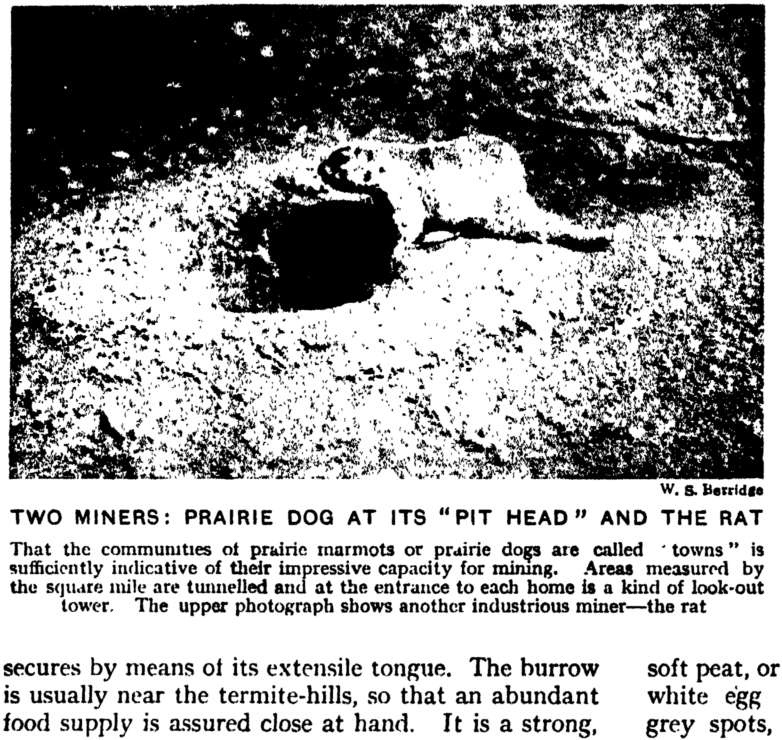
In the nature of its food the mole is a friend of the agriculturist, but in some fields and gardens its tunnellings become a nuisance. It acts, in a way, as a natural drainage producer, but there are a few fields known to me which are almost uncultivatable because of the great number of hillocks of soil that are thrown up daily all the year round. Even in hard, frosty weather the mole still pursues its active operations beneath the surface, and knows no rest.

The curious duck-billed platypus, one of the few egg-laying mammals of the world, is of aquatic habits, and lives in pairs in burrows made in the banks of fresh-water rivers in Australia and Tasmania. It is very shy, and will submerge its body as soon as it is spotted. The burrow is an ingenious affair, there being two entrances, one above and the other below the water-line. At the extremity of the burrow—often extending to fifty feet—the platypus makes a cosy nest in a widened terminal chamber. In this nest two white eggs are deposited. The food secured by this remarkable mammal is not eaten straight away, as it is first stored up in large pouches situate on each cheek, and then consumed as required.

The aard-vark is another mammal overseas that may be included in our present census of miners and tunnellers. Its Dutch name means "earth pig," and to the colonists in South Africa it is known as the ant bear. It is not by any means a nice-looking animal, having a small, pointed head, very long ears, large body, stumpy legs, and a long, tapering tail. It also has a long tongue. On the front pair of legs there are four toes armed with powerful nails, whereas the hind feet have five toes. The skin is thick. Nocturnal in habits, the aard-vark makes a deep burrow in the soil, and there, during the day, it passes the time asleep, coming out under cover of darkness to feed on termites and ants which it



b Crook



W. S. Berridge

TWO MINERS: PRAIRIE DOG AT ITS "PIT HEAD" AND THE RAT

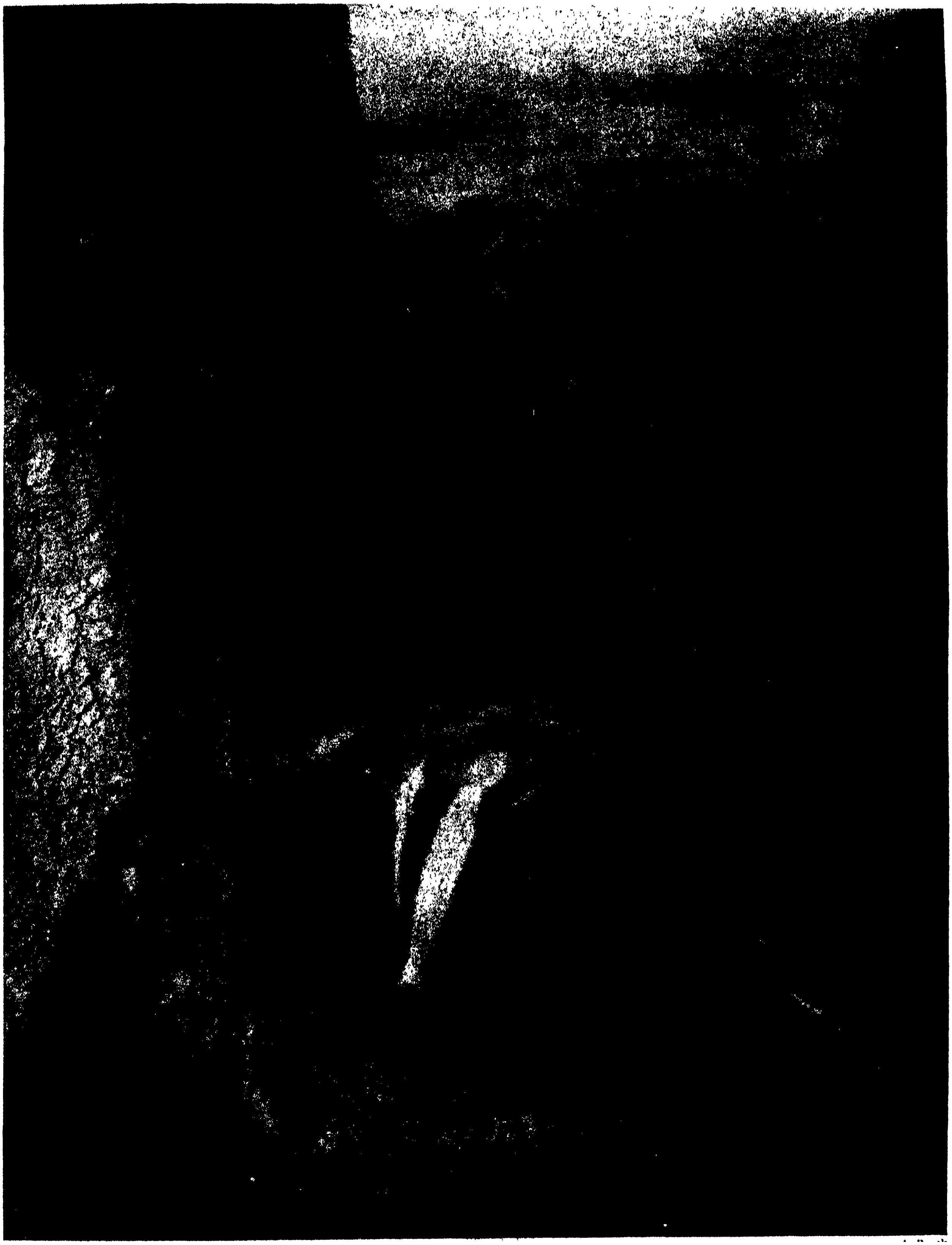
That the communities of prairie marmots or prairie dogs are called "towns" is sufficiently indicative of their impressive capacity for mining. Areas measured by the square mile are tunnelled and at the entrance to each home is a kind of look-out tower. The upper photograph shows another industrious miner—the rat

secures by means of its extensile tongue. The burrow is usually near the termite-hills, so that an abundant food supply is assured close at hand. It is a strong, powerful animal, endowed with great digging propensities, and although it measures as much as six feet in length, the whole body can soon be buried, even in hard ground. The front feet are used for digging and the hind ones for throwing out the soil.

Several kinds of birds are to be numbered as miners, tunnellers, or burrowers. Among the latter is the burrowing owl, which inhabits regions similar to the prairie marmot already referred to. It differs from many others of its race by being diurnal in habits, standing on guard at the entrance to its burrow for hours at a stretch. It often usurps the burrow of the marmot, as also does the rattlesnake. It is not a happy arrangement except for the bird, as this small owl is a match both for the mammal and the reptile. Sometimes, it is said, the burrowing owl will take up residence in the "earths" of badger, fox, viscacha, wolf, and other underground animals, but it is an open question whether, in spite of its popular name, it burrows to any very great extent.

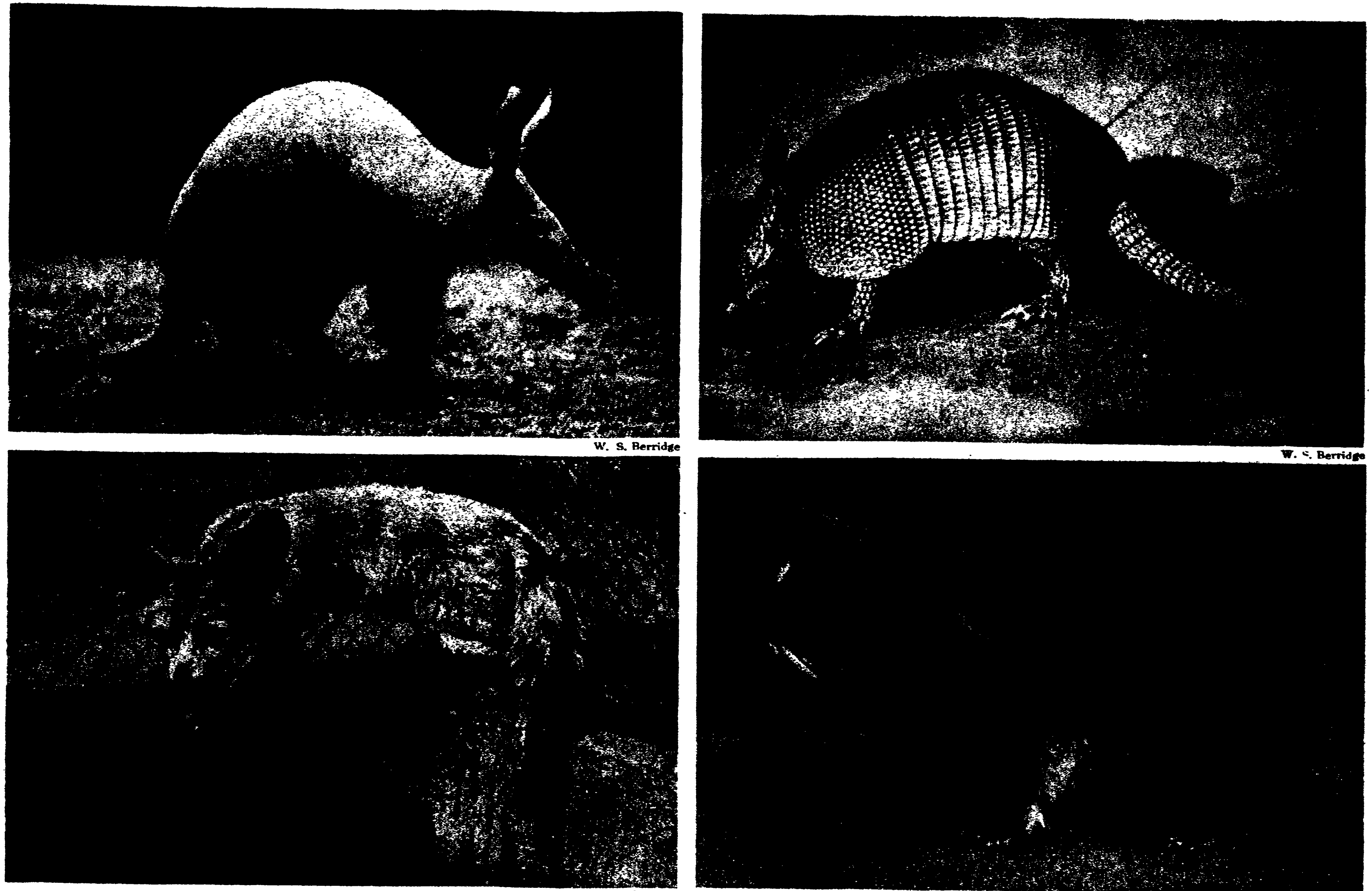
The puffin is a British bird well known to residents in coastal districts. This can confidently be called a burrowing bird. Grotesque in appearance, with a lurid-coloured sheath over its beak in the breeding season, the puffin, or sea parrot, as the fisherfolk call it, places its one egg in a burrow in the ground. In St. Kilda the burrow is made in the soft peat, or a cleft in the rocks may be chosen. The white egg is sparingly marked with brown and grey spots, and it is suggested that it is comparatively recently that this bird has adopted the habit of depositing its egg in burrows, as the eggs of birds which lay in holes are usually white and unmarked

ONE of the species of shearwater, a sea-bird of much interest, has been called mutton bird by sailors, apparently because the young are so very fat. The other name is perhaps obtained from the habit this bird has of shearing the water. However that may



BADGER EMERGING FROM ITS HOME BENEATH THE ROOTS OF A TREE

If undisturbed a colony of badgers may occupy the same site for centuries, and badger earths have been found fifteen feet below ground and dug the whole distance through solid chalk. Favourite sites are thick woods and the burrows are made under the roots of trees. The badger seen above has such a home with the burrow coming to the surface just where two projections from the bole of the tree make a frame for the entrance. The cautious animal, very seldom seen in daylight or indeed at all, exists even in the grounds of Ken Wood on Hampstead Heath.



W. S. Berridge

W. S. Berridge

F. W Bond

W. S. Berridge

FOUR MAMMALS THAT ARE MINERS: FENNEC, MOLE-RAT, AARD-VARK AND ARMADILLO

Living in burrows in the deserts of North Africa the fennec (bottom left) is a small, fox-like member of the dog family and distinguished by its enormous ears. The mole-rats, of which we have a specimen here (bottom right) known as Zech's mole-rat, are found in East Africa, south-eastern Europe and in Asia. They live on roots which they obtain by tunnelling. Notice the well-developed teeth and efficient-looking jaws. In the upper left hand photograph we have a giant among animal miners, the aard-vark, which is six feet long but can bury itself, even in a hard soil, in a very short time. It has strong nails and lives in a deep burrow. The nine-banded armadillo (top right) of South America is also a very quick digger.

Martin Duncan

be our interest lies in the fact that all shearwaters deposit their one pure white egg in a hole underground. Previously their numbers were enormous off the Australian coast, but when it is stated that as many as sixty thousand breeding birds have been destroyed in one season, small wonder need be expressed at its partial disappearance from the list of the world's avifauna.

A familiar visitor during the English summer, the sand martin—a member of the swallow tribe—is characterised by its unfailing habit of tunnelling into sandpits and cliff faces. For so small a bird, provided only with a short, sharp beak, the long tunnels that are mined—just beyond arm's length—are truly remarkable. Little colonies of these energetic birds nest together, and at the extremity of the aperture the nest is placed. The small pyriform eggs are pure white. The mouse-coloured plumage of this useful little species—it is entirely insectivorous—at once distinguishes it from its larger cousin which nests under the eaves of the houses and also from the swift-winged swallow.

Bastin

A DESTRUCTIVE BURROWER BENEATH PLANTS

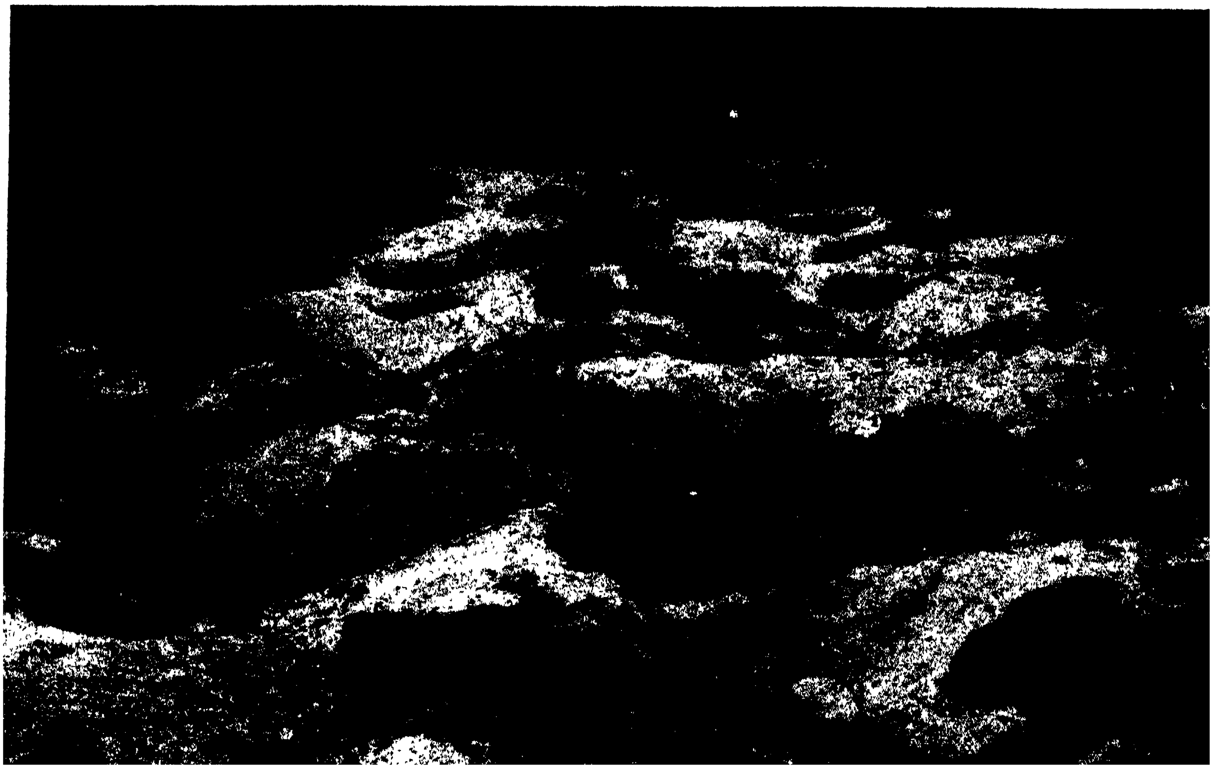
Mole crickets are quite common in the British Isles, but are rarely seen because they spend their lives underground, burrowing like moles and feeding upon the roots of plants. The eggs are laid in a cavity made at the end of a burrow. The lower photograph shows the insect as a man sees it, from above, while the top illustration gives us a side view.

The Elegant tortoise of South Africa digs a shallow pit in the earth in which to deposit its eggs, sealing up the hole with the soil excavated so as to hide the treasures completely. Another species, the familiar Grecian tortoise, not only places its eggs in a hole in the earth, but excavates a burrow in which to pass the winter, the strong fore limbs being used.

Snakes use the holes or burrows of other animals in which to conceal themselves during the period of hibernation, as also do frogs, toads, newts, and other creatures which are inactive during hard weather, but they hardly come within our category.

On the other hand, there are many marine animals that are expert miners and tunnellers, some of which will have come under the observation of the reader. Perhaps the crab found promenading on the seashore is the most typical example that may first be mentioned, as, although it does not live in a burrow, the incredible way in which the creature can disappear under sand or shingle will have been witnessed by all visitors to the seaside. Whilst the crab can and does amble above ground at quite a good speed in order to escape its pursuer, it is rather by rapid self-burial that it avoids detection and depends for its survival, at least from human enemies. If seen in one of the pools left by the tide the crab disappears in double-quick time, its legs moving with mechanical precision as it hastens to cover itself with sand, and then remains motionless. Even if a leg is lost, little ado is made of such an accident, as another one is grown to take the place of the missing limb in the same way that the lizard grows another tail.

WANDERING along the shore making, perchance, a collection of the different kinds of shells thrown up by the sea and from which the soft bodies of the owners have disappeared, one may almost certainly



Otho Webb

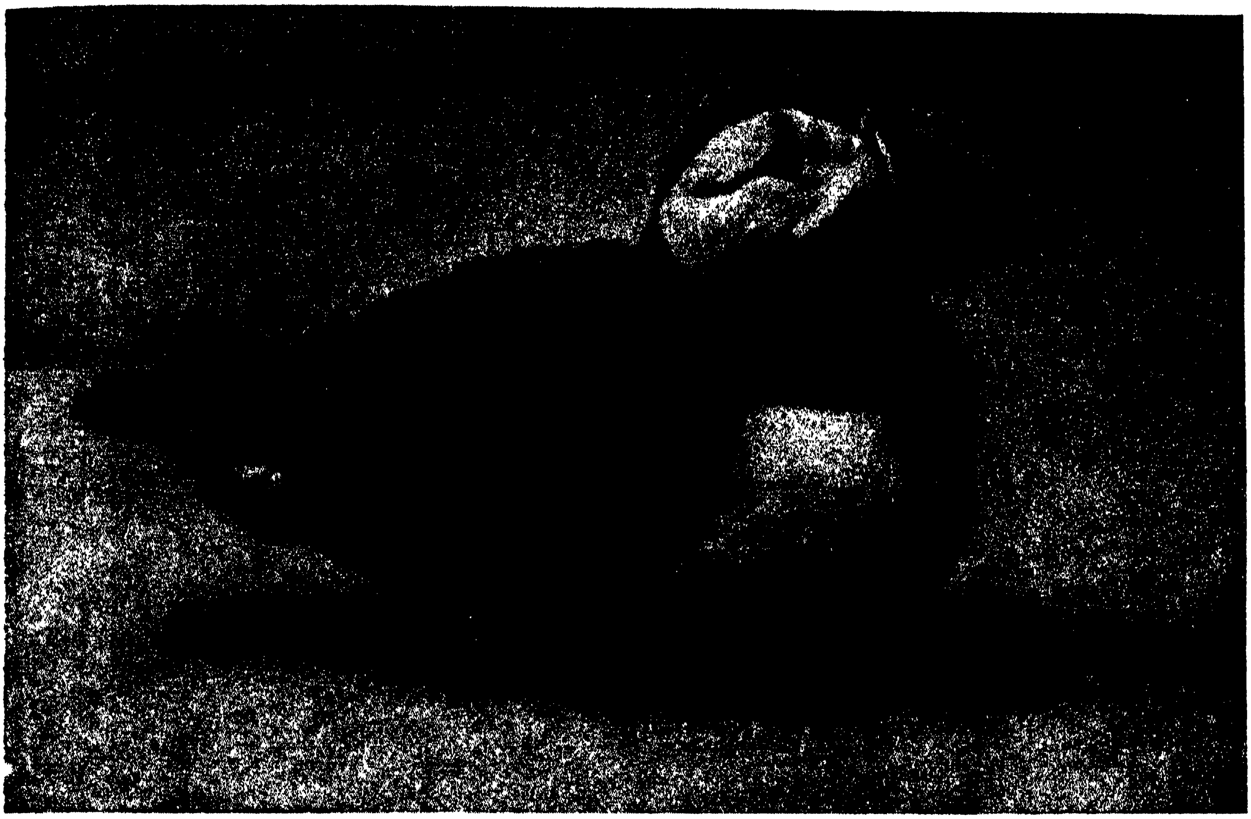
SHEARWATER OF THE BARRIER REEF ISLANDS

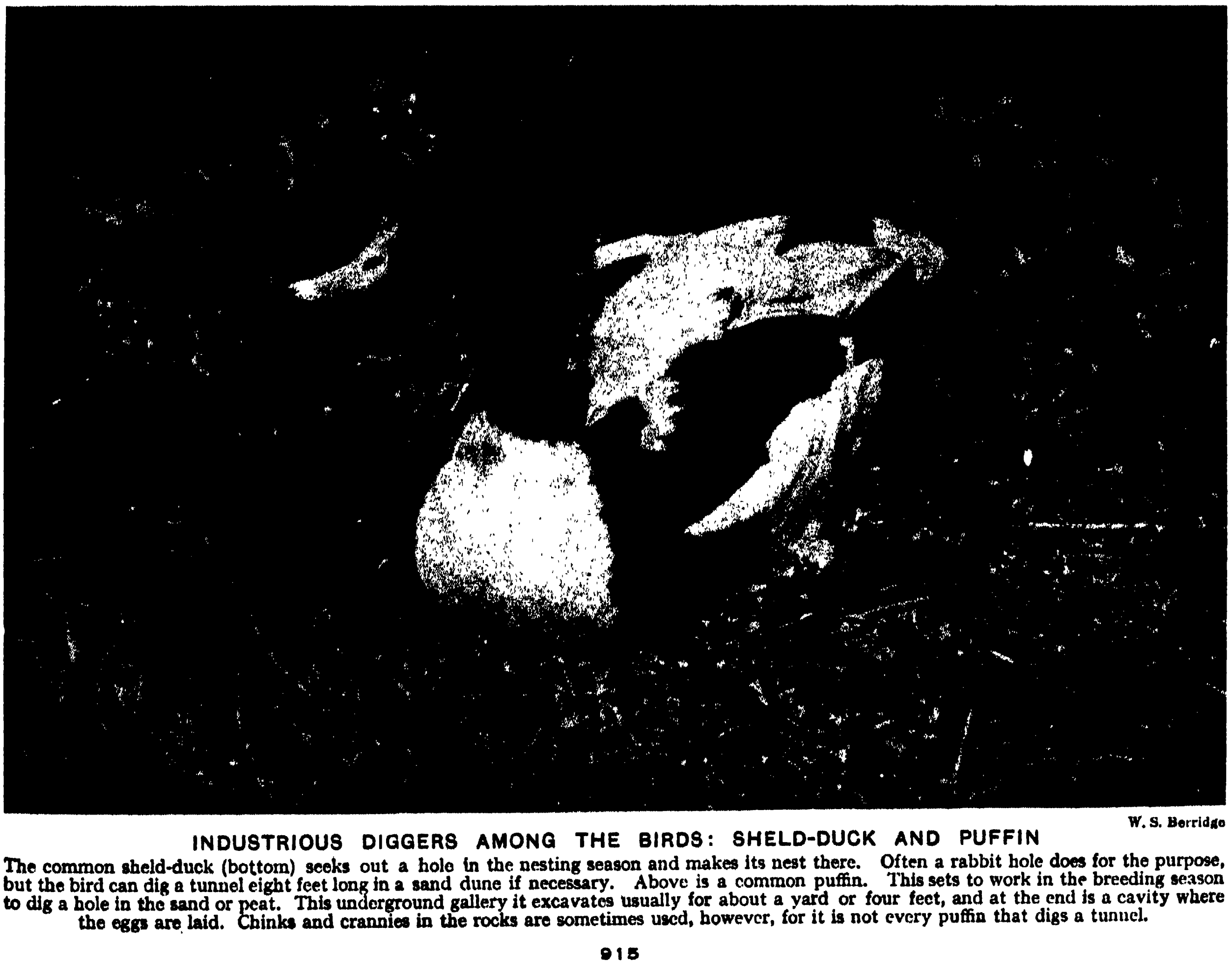
The wedge-tailed shearwater used to nest in its thousands on many islands of the Great Barrier Reef, although persecution has since led almost to its extinction. It burrows and at the end of its tunnel lays its eggs. An egg (bottom) has been brought to the mouth of the tunnel so as to be visible to the camera. Above is a general view of a honeycombed island haunted by shearwaters.

pick up two kinds of shells of common occurrence. One is the well-known razor shell, having two halves joined together with an outside hinge in the centre, and the second is a pure white-ribbed shell, tapering almost to a point, known as pholas. Both these sea dwellers are capable burrowers, as we shall now discover. The razor shellfish is the possessor of a large and powerful foot with which it burrows deeply in the sand. Not only does this species bore a great depth in the sand, but it does so with much rapidity. It is not often that the animal can be obtained alive, and its shells are usually the only reminders of its one-time life in the sea.

Walking one day on a sandy shore in Lincolnshire, I was interested to find many pieces of hard clay and nodules of chalk worn smooth by the action of the water. In these pieces of clay and chalk there were several symmetrical holes running right through, and I was puzzled as to the cause until I discovered several pairs of pure white shells tightly wedged in some of the holes. Here, then, was a solution of the mystery. The owner of the shell was *Pholas dactylus*. The shell is thin, but of much strength, and is used, in conjunction with the foot, for boring purposes, the former acting as a file to enlarge the hole as necessity arises. Many species of pholas are phosphorescent.

The teredo, or ship's worm, is a close relative of the last named, and does immense damage by boring into submerged timber in jetties and breakwaters.

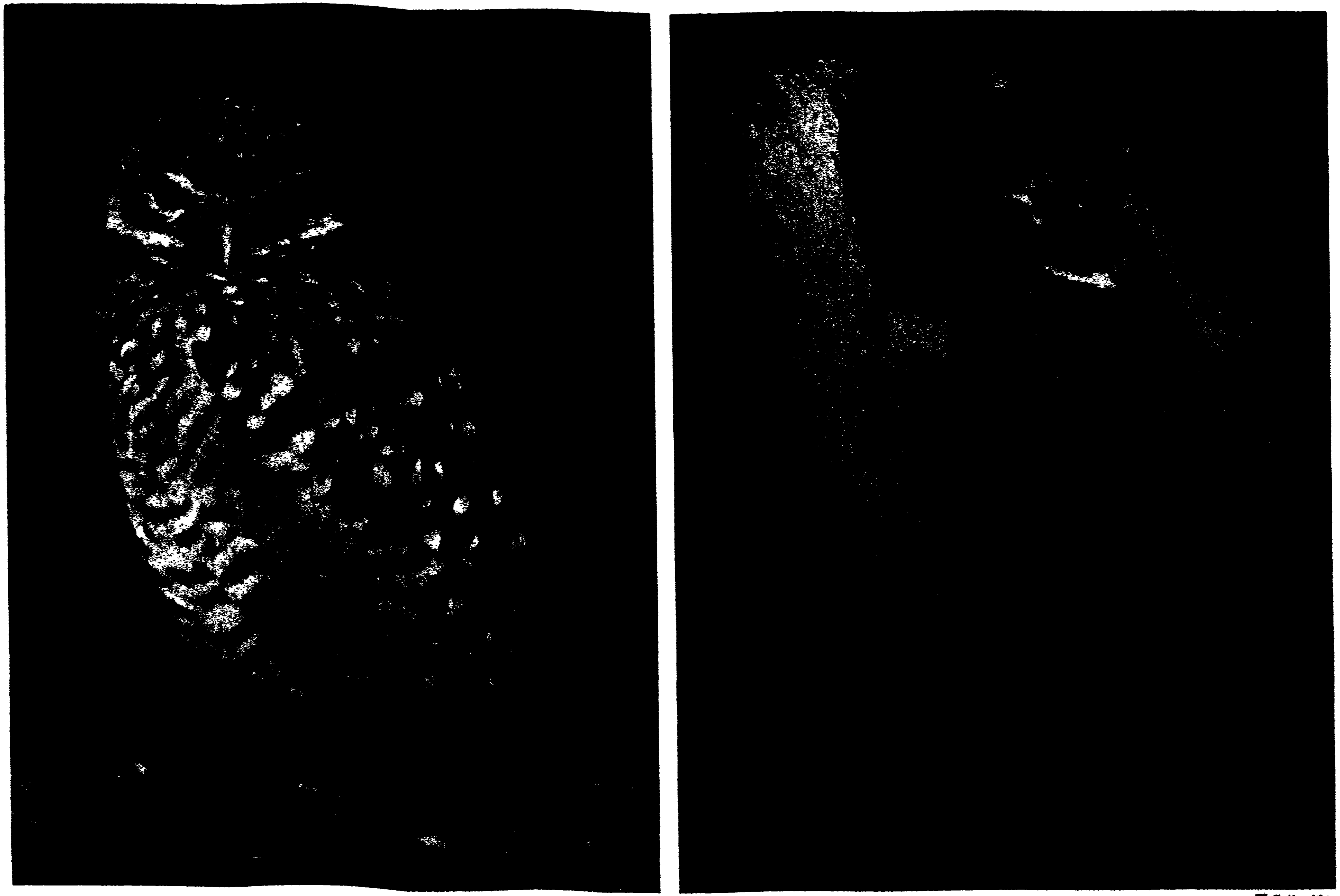




W. S. Berridge

INDUSTRIOUS DIGGERS AMONG THE BIRDS: SHELD-DUCK AND PUFFIN

The common sheld-duck (bottom) seeks out a hole in the nesting season and makes its nest there. Often a rabbit hole does for the purpose, but the bird can dig a tunnel eight feet long in a sand dune if necessary. Above is a common puffin. This sets to work in the breeding season to dig a hole in the sand or peat. This underground gallery it excavates usually for about a yard or four feet, and at the end is a cavity where the eggs are laid. Chinks and crannies in the rocks are sometimes used, however, for it is not every puffin that digs a tunnel.



W. S. Berridge

BURROWING OWL WHOSE HOME IS UNDERGROUND, AND THE TUNNELLING SAND MARTIN

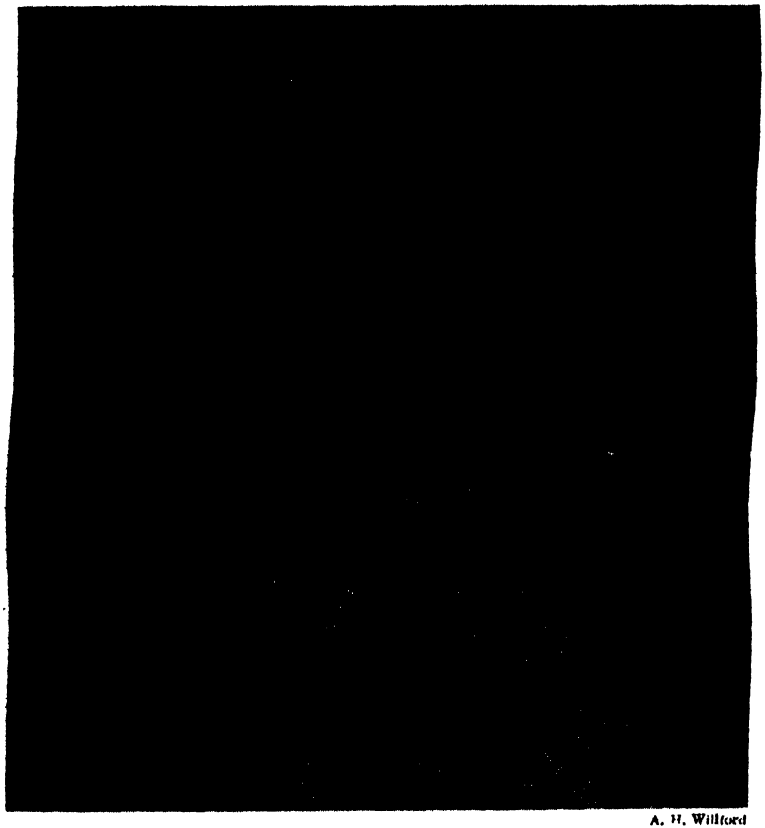
In both North and South America there are burrowing owls. These indeed cannot take very much credit for their ability as sappers, for they merely adapt some other creature's burrow to their own purposes. Badgers, prairie dogs and foxes may find their earths suddenly shared by these bold intruders, and it is believed that, in some cases, the owl attacks the offspring of its hosts and even the hosts themselves if they be of the vulnerable sort. The right-hand photograph shows a sand martin at the mouth of the hole in a cliff which the bird has drilled out. The passage leading to the nest cavity is often three feet long and the cavity itself is furnished with hay or straw and a feather lining.

Another marine creature known as Rocellaria bores into solid rock, and one species at least is capable of successful operation even into such a hard substance as granite.

Date shells may be aptly termed stone-borers, master navvies of marine life. The shells are thin, and shaped something like the favourite date fruit. The boring is performed by the foot, and Lydekker mentions the interesting fact that the columns of a temple at Puteoli are impregnated with holes caused by a species of date shell at a time when these wonderful ruins were lying submerged beneath the sea.

One would hardly associate sponges with boring animals, but some species of burrowing sponges are capable of riddling blocks of limestone rock until the latter is almost honeycombed with their ravages. They also perpetrate damage among oysters.

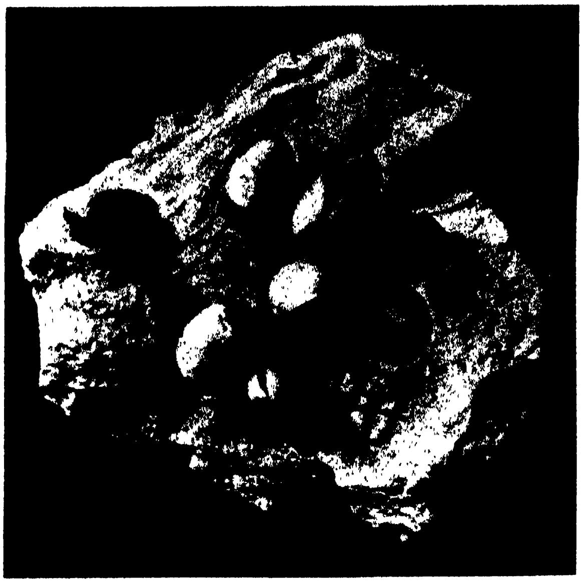
Among the lower forms of life the common earthworm is one of the best-known examples, and its work as a tunneller in the soil is familiar to all. When excavating a Roman cemetery site at Baldock, Herts, I was much struck, not only at the enormous size of the earthworms there encountered and their plentifulness, but also at the great depth at which these soft-bodied animals were found and the hard chalk rock and rubble through which they were able to make their way with ease and facility. Earthworms are night roamers, coming above ground to deposit their castings and to feed. They are vegetarians, feeding upon dead and decaying leaves and other vegetable matter. Quick of movement when on terra firma, retreating within their holes with much rapidity, these beneficent creatures, as Darwin has shown, have been of prime assistance in helping through the ages to make the soil fit to till. They also supply hungry birds and other creatures with food, including our homely friend the robin, which, it is computed, devours several feet of earthworms per day.



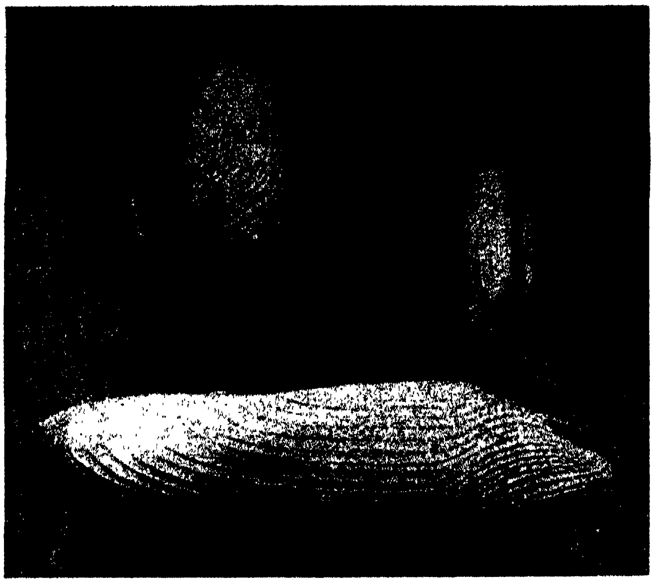
A. H. Willford

SUBTERRANEAN NESTS DISCOVERED TO THE CAMERA

Here are two photographs discovering nests which are built at the end of subterranean passages. The sand martin (bottom) lines her nest comfortably with feathers as we see. The young burrowing owls photographed in their burrow (top) are probably only a few inches from the surface in spite of their apparent seclusion.

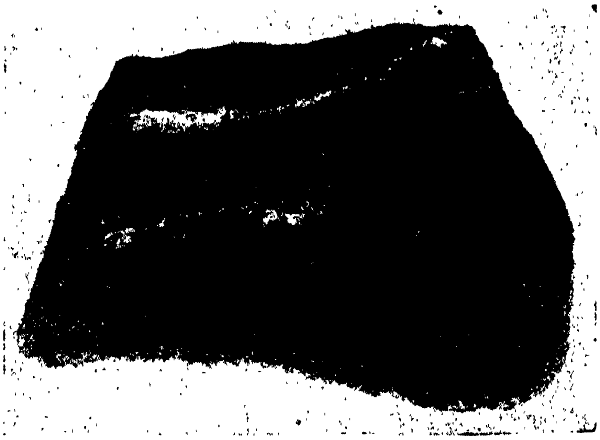


Date-shells boring in stone

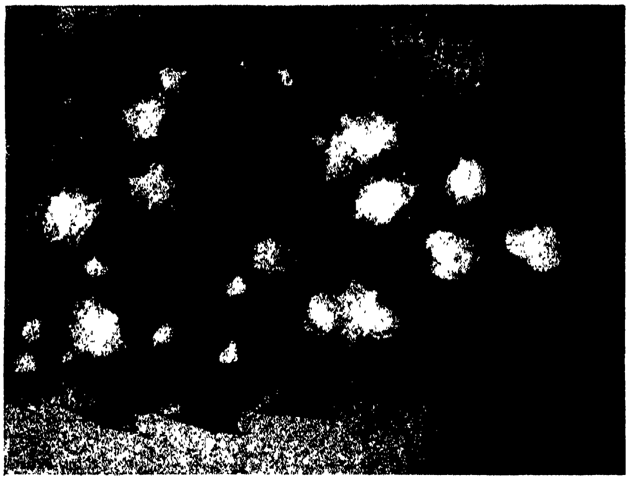


Great, medium, and short piddocks

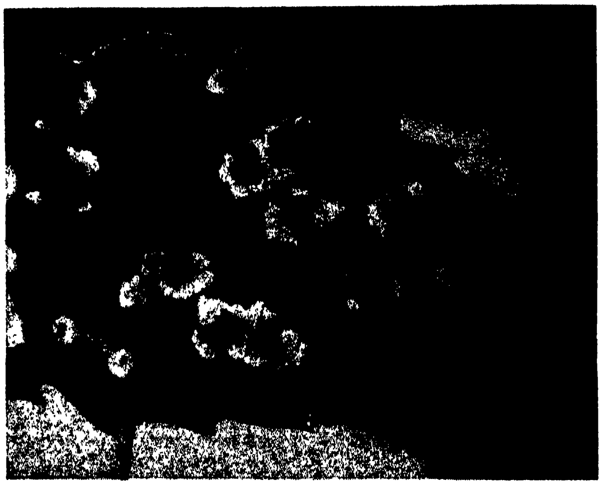
Timber honeycombed by the teredo



Burrows of a miner bee in sandstone



Chestnut leaf mined by a small moth



The moth caterpillars seen in the mined areas

LITTLE BURROWERS AND BORERS IN LEAF, WOOD AND STONE

About the most subtle mining in the animal kingdom is done by the larva of a micro-moth—*Lithocelletis messamella*—the little grubs eating out a space within the thickness of the leaf of a Spanish chestnut (bottom left). The bottom right-hand photograph gives us the same leaf photographed against the light to show each tiny caterpillar in its " mine." The date-shells (top left) are little sea molluscs with a special "foot" which bores through stones. Photos by E. J. Manley, M. Duncan, J. J Ward, and H. Bastin.

Green shore crab digging itself in

The crab nearly buried

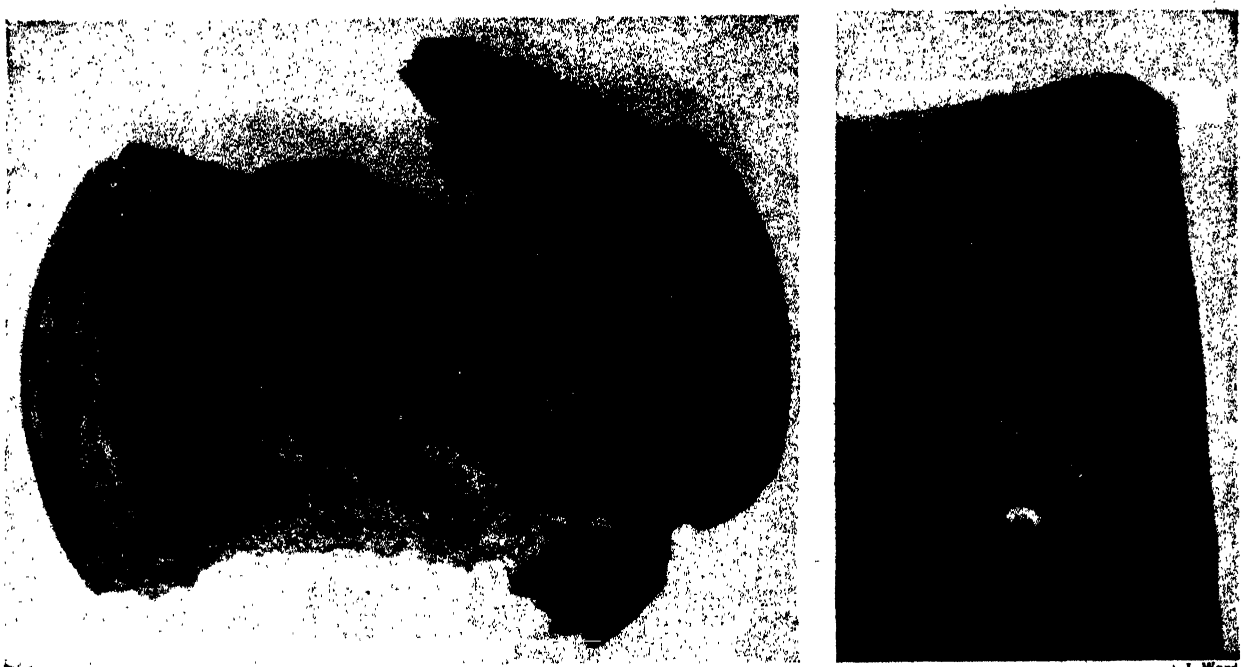
Alder fly larva on a stone in the water

The larva burying itself under the stone

European burrowing toad digging itself a shelter

QUICK DIGGERS AT WORK IN TIME OF DANGER; BURROWING TOAD, FLY LARVA AND CRAB

The burrowing toad (bottom) has spade-like projections on its feet by means of which it is able to bury itself. One African species uses this digging ability to attack the nests of termites, for it has a partiality for these "white ants" as food. The larva of the alder fly (centre photographs) develops under water and in times of danger buries itself. One of the quickest diggers is the green shore crab (top) whose legs operate with the precision of a steam shovel. Photos by W. S. Berridge, S. C. Johnson, and M. H. Crawford.

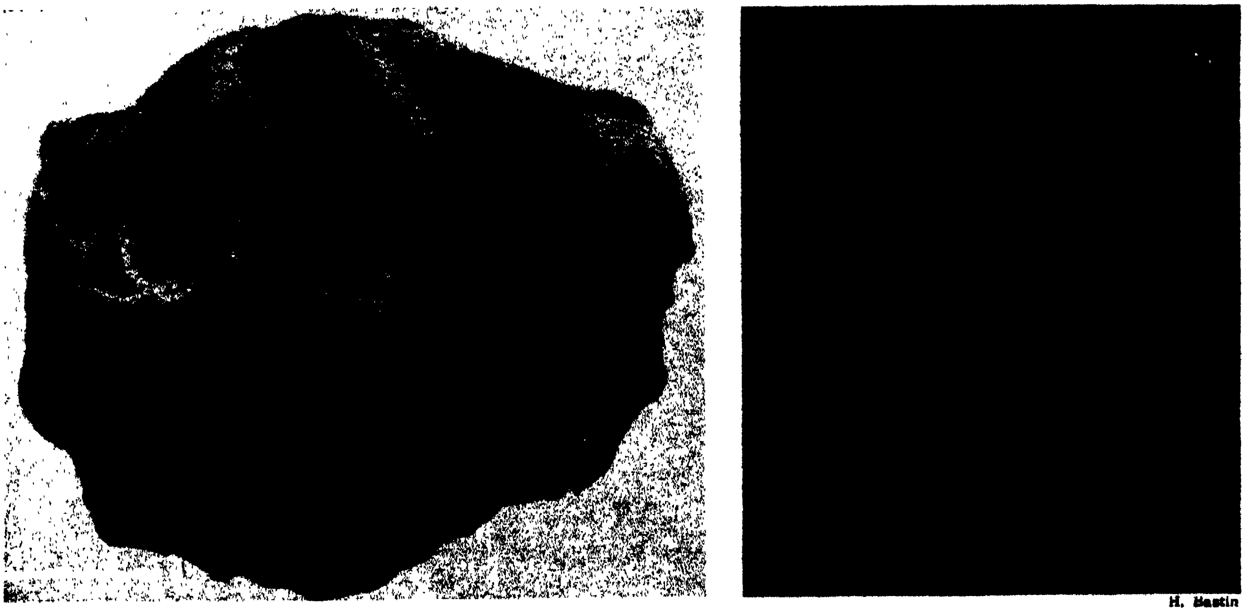


I. J. Ward

"DEATH-WATCH" THAT BORES WOOD AND A WEEVIL THAT BURROWS IN BISCUITS

Grubs of the so-called death-watch beetle do enormous damage to woodwork unless quickly and severely dealt with. The photograph on the left shows the wooden plate used for fastening a gas bracket to a wall, and it is riddled with the little tunnels made by busy grubs. The other illustration is of a piece of ship's biscuit which has been attacked by the weevil *Anobium paniceum*. This is an ancient foe of mariners, and a bag of biscuit, once infected, is very speedily destroyed

There are numerous beetles which make the ground beneath our feet their dwelling-place. The cocktail beetle, or devil's coach horse, is one of these. It is an all-black, flat-bodied creature, and has the habit of quickly erecting its hinder parts when disturbed and assuming a threatening attitude. When digging in the garden other beetles—some jet-black, others dark green and violet coloured—will be disturbed from their hiding-places. They soon disappear again, but it is rather amazing to discover how clean their bodies are when one reflects that the soil is their constant abiding place.



H. Bastin

BURROW HOMES OF SOLITARY BEES SEEN AT CLOSE QUARTERS

Among the various kinds of solitary bees, as opposed to the social bees which live together in hives, are the flower-bees or *Anthophora*. They look much like humble bees and burrow in the ground to make their solitary homes. The cells (left) in which the eggs are deposited are constructed from the soil or, if the home is made in the cleft of a tree, out of wood. The right-hand photograph shows some burrows of a species of the same genus, *Andrena*, seen from above. The burrow on the right has freshly excavated earth round it.

LITTLE ARMADILLO, A WONDERFUL TUNNELLER OF THE NEW WORLD

Provided with strong claws, the forelimbs of the armadillo are very efficient shovels. These little animals most armadillos are about the size of a rabbit can bury themselves with surprising speed, especially those that live in the sandy pampa country of South America or in the deserts of Texas. Some localities are positively honeycombed with the burrows of these armoured miners of the New World

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Chapter LXXXIII

Animals that Live Upside-Down

By Frank Finn

Author of "Birds of the Countryside"

AMERICA has never been backward in advertising, and her native live stock, even from the earliest times, have enjoyed a "good Press." The sloth has thus long been well known, but not accurately known, for all sorts of stories have been told about it, from the old one which credits it with being a monstrous, imperfect creature which could only crawl at the rate of three yards an hour and descended from a tree, eaten bare, by tumbling down with a whack and a wail, to the modern ones which credit it with bounding from tree to tree, or with all the paces of other kinds of quadruped, including even the gallop.

It does indeed deserve its notoriety, for, being as big as a small dog, it is the largest of the large number of animals which live upside-down.

This accounts for the tales about its imperfections, for on the ground, and from our point of view right-side up, it can only haul, sprawl, and crawl; but when it gets to a tree and has clambered on to the boughs, it is in its right element and reverses itself joyfully, clinging with no effort to the boughs by its long, hook-like claws, which also serve, in the case of the long fore-limbs, to drag branches within reach when the beast wishes to devour their leaves. Unless deficiency of arboreal accommodation, very unlikely in the New World tropical forests in which it lives, forces it to the ground, the sloth does everything suspended, "in fact, passes its whole life in suspense, like a young clergyman distantly related to a bishop," as Sydney Smith, with a cynical imputation of Simonism to his cloth, said when reviewing Charles Waterton's "Wanderings in South America."

THE proverb "It's an ill wind that blows nobody good" would be appreciated by the sloth if he could understand it, for windy weather gives him a chance of changing quarters without descending to the hated earth, since when the boughs of an otherwise inaccessible tree sway near those of that which is his base for the time being, he can claw out and shift over. He can do quite well without drinking, like so many vegetarian mammals, but will take to water and swim if necessary, his haul, sprawl and crawl method of progression, when on the ground, lending itself naturally to swimming, as indeed does the gait of most land animals. The biped gibbon ape cannot swim, any more than we can if untaught, because its land movements are unsuitable, and the throwing up of the arms does more harm than good.

The baby sloth, clinging to its mother's shaggy breast-fur, perforce lives right-side up for a time; and about the sloth's fur there is a very remarkable point—it is minutely fluted, and in the beast's native home affords congenial lodgment for minute plant-growth of the type which colours green old walls and woodwork in England. Thus the sloth in the wilds is a green beast, but under the changed and drier conditions of captivity, or in the preserved skin, the green growth disappears. It must be of some service in protecting the beast, which is really not a very brisk mover at the best of times, from its natural enemies such as the harpy "eagle"—the giant of the hawks—and the jaguar, the American improved edition of the leopard. But the sloth also seeks security from such foes by keeping well up and out among the twigs, where a heavy beast could find no foothold, and a bird might get "hung up" in endeavouring to help itself with its wings.

In captivity the sloth does well enough, but is rarely seen, as it has about as poor recommendations for a cage, except as a scientific exhibit, as any beast well could have. There are several species, some with two toes only on the forefeet, and some with three; and, what is really most remarkable, in these two types of this humble group of beasts, the standard specification for mammalian neck-vertebrae is twice departed from. Seven is the rigid rule for practically neckless whale as well as for over-necked giraffe; but the three-toed sloths have nine, and, lest it should be concluded that the extra allowance is needed by an animal which from its position needs to twist its neck a lot, and does so, we find the two-toed sloths showing the normal seven in one species and actually one less than the normal in another.

BATS, as everyone knows, hang up by their heels when in repose, but as they pass so much of their time on the wing, can hardly be said to live upside-down, except in the case of the fruit-eating flying foxes, which do not usually fly except to reach their feeding trees, and when there scramble about back downward in a very sloth-like fashion, besides hanging up at their roosts in the usual topsy-turvy bat fashion.

Birds dislike being upside-down even more than most beasts, though some, like many beasts, will roll over readily enough in fun or for fighting, like parrots and birds of prey; many also, as everyone has seen with tomtits, reverse readily when feeding. But the only birds which spend most of their time in a reversed position are the pretty East Indian hanging-parrakeets, or bat-parrots, to give them a better and a briefer name. These are little green, bob-tailed, sparrow-sized parrots, very like the "love-birds"; but while those are seed-eaters, the bat-parrots live on the nectar of flowers and on soft fruit. To get food like this, they need to reverse as often as tits; but when they rest or go to sleep at nights, they always hang up by their feet bat-fashion, so that on the whole, they must spend more time head-downward than the right way up. They are not common in captivity, but a few turn up at the great bird shows.

W. S. Berridge

SLOW LORIS OF TROPICAL ASIA TAKES A REST IN A CHARACTERISTIC POSE

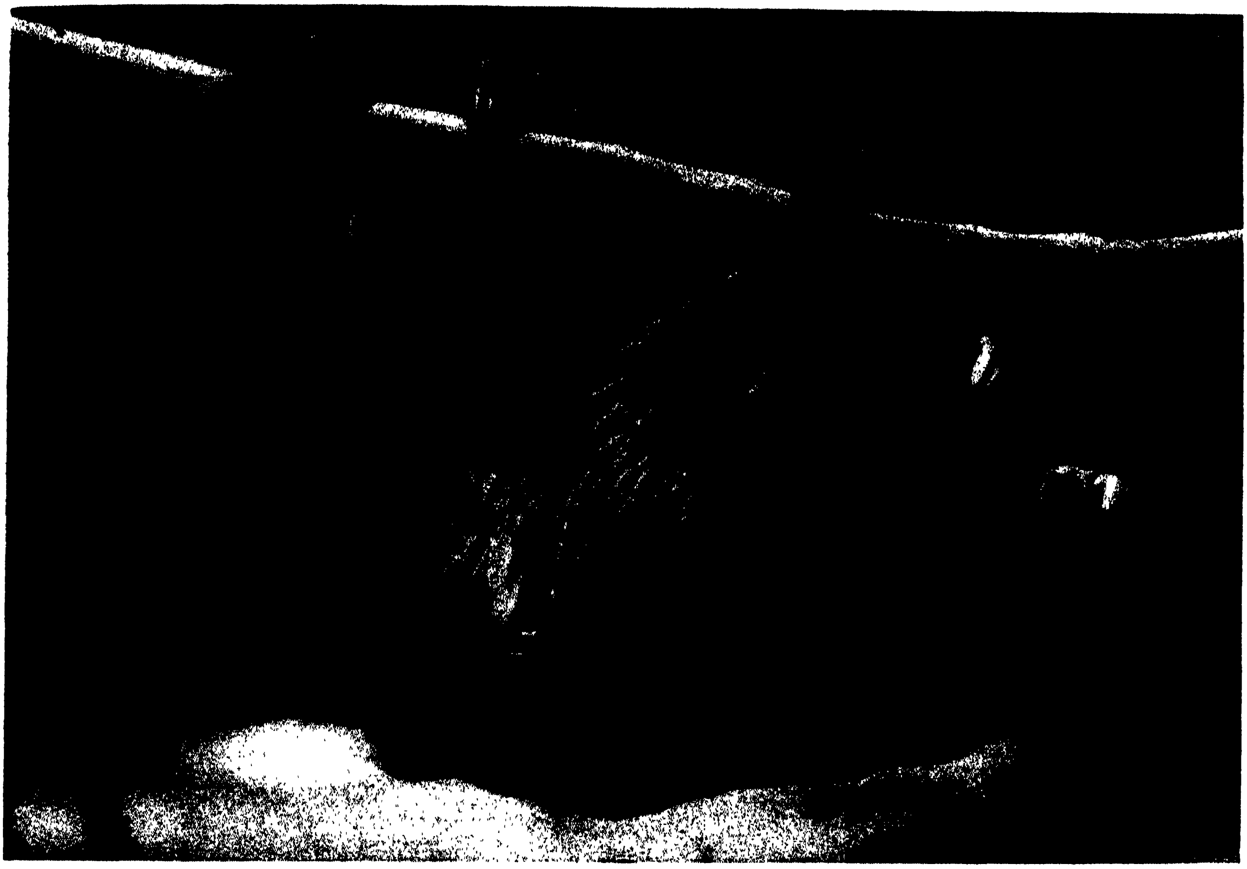
Inhabiting northern India, the Malay peninsula and the Dutch East Indies, the various kinds of loris form a group of tropical lemurs. The one above is known, from its very deliberate movements, as the slow loris. It has the large eyes of the nocturnal animal and gets a living by crawling with extreme stealth about trees at night and grabbing any insect or small bird it comes across. The birds are preyed upon while they are asleep. The animal always rests upside-down, as we see it here.

The larger honey-eating parrots belonging to the distinct group of lories are also fond of hanging head downwards, if not actually sleeping so ; and squirrels may often be seen doing the same thing, so that here we see the beginnings of a possible topsy-turvy habit in both beasts and birds.

Lories, by the way, will roll over on their backs in play more readily even than other parrots, and the large Indian flying-squirrel sleeps on its back, like some of the armadillos—a very rare habit, for nearly all animals, even if upside-down, do not lie with their limbs free, but like to be in touch with their base ; the statement that man is the only animal that lies on his back from choice is nearly correct, if by lying one understands sleeping.

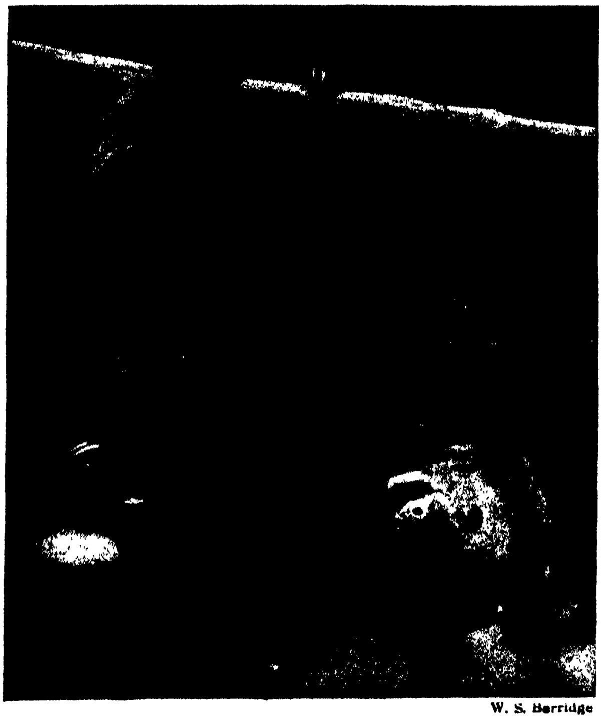
THE geckos among the lizards, which climb on any surface, horizontal or perpendicular, by means of the rows of transverse sucker-plates on their broad toes, must often live upside-down, when their hunting-ground is the ceiling of a room or cave, and they often repose head downwards ; but as a group they are not specialists in topsy-turvy life, but simply ignore orientation and travel and repose anyhow. Otherwise, reptiles as a class have a stronger objection to the upside-down position even than birds ; and as to fish, it is well known that a fish upside-down, if not a dead fish, is a very sick one. There are, however, two very remarkable cases of fish which affect this position. One is that of some African fish of the genus Synodontis, which belong to the curious whiskered family of cat-fish, well known to aquarists in the person of the commonest American species. These fish have many eccentric habits, but the speciality of Synodontis is swimming upside-down ; to this, two species found in the Nile are especially addicted, and the ancient Egyptians, who missed very little in the way of natural curiosities, have so represented them in their art. These two are noticeable for having the usual fish-coloration reversed, for they have the under parts darkened and the upper silvered ; this is no doubt an adaptation to the upside-down position, for a silvery surface exposed to the light would be simply asking for trouble from winged enemies which are only too quick to provide it for fish in any case.

The other case is that of the well-known Remora, or sucking-fish, which has so long and wide a reputation as a stuck-on stowaway with any craft, man-made or animate like shark or turtle, which may



give it free passage. The attachment is effected by a patch of sucking-plates somewhat like those on the toes of the geckos, and as this patch is on the top of the head, the fish must be often actually upside-down, and in any case has its back to its base and its underparts exposed to the outside world of the sea it traverses. The ancients, by a mistake not easy to understand, credited it with being positively able to stop any ship it joined.

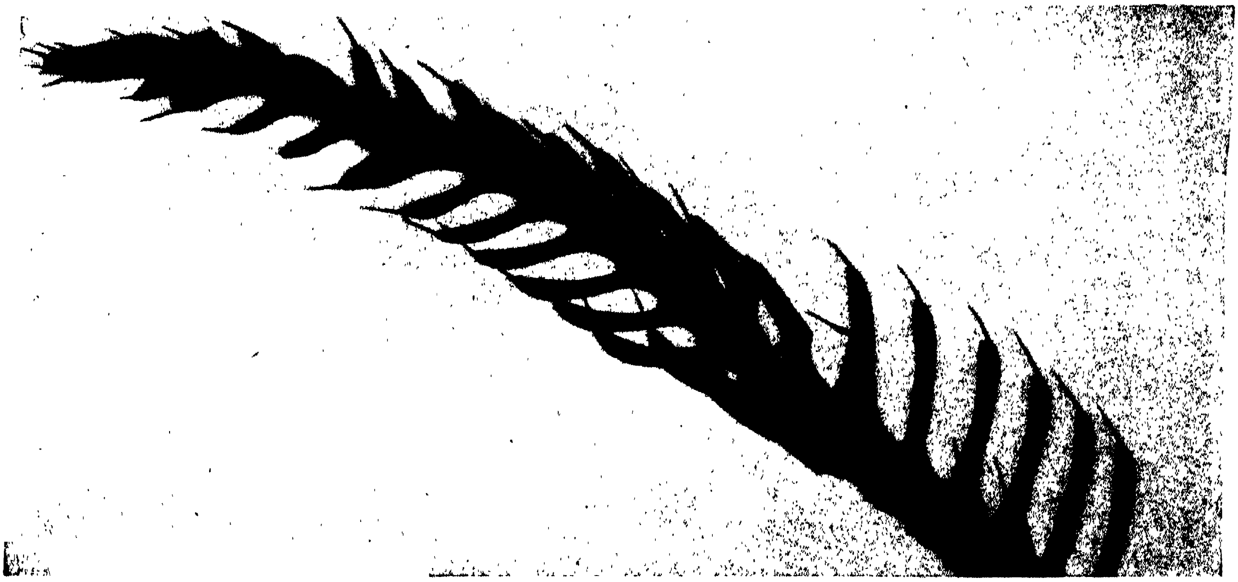
When we come to the great rivals of the back-boned animals, the arthropods, or armour-plated tribe, we have no difficulty in finding lives lived in reverse. The cockney sparrow has not much opportunity for Nature-study, and knows so little about his own feathered class, that the writer has seen a specimen snapped up by a gull, which he evidently did not classify apart from ducks; but he is rather a good practical entomologist, and knows quite well that insects are to be looked for underneath leaves, and therefore hanging on upside-down. Caterpillars, it is true, will turn into flying creatures which will pass most of their lives right side up, but they are scarce compared with the myriads of aphides or plant-lice found under leaves, that produce several generations before winged forms appear, which must be upside-down livers all their short lives. The advantage to such little creatures in living in this way is obvious: a shower of rain would exterminate them wholesale if they did not take cover quickly

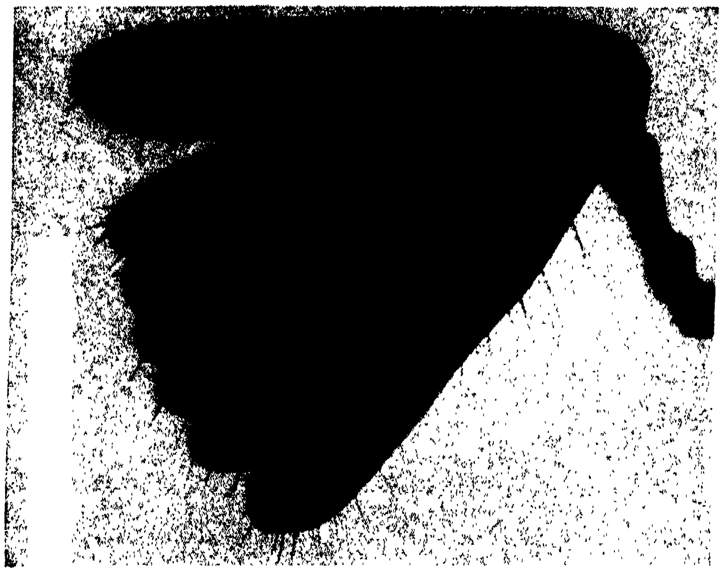


W. S. Berridge

CHARACTERISTIC SLOTH ATTITUDES

Another name for the two-toed sloth, of which the above are examples, is the unau, and it lives in Brazil. The epithet two-toed applies only to the fore-feet. It habitually hangs upside-down, and its eyesight and hearing are both said to be remarkably poor.





J. J. Ward

ANTENNAE OF COCKCHAFER AND MOTH

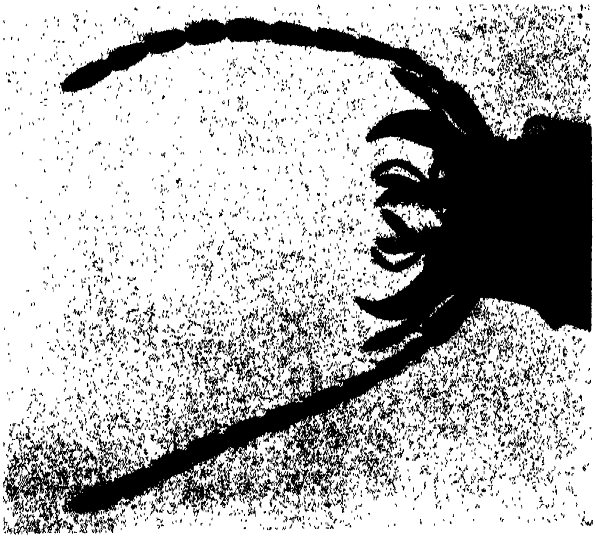
The lower illustration is of part of the antennae of a cockchafer much magnified, and shows the plates with their sensitive hairs. Above is the antennae (enlarged) of a male tiger moth. It is the caterpillar of the garden tiger that is known as the "woolly bear" and it is thickly covered with very sensitive hairs.

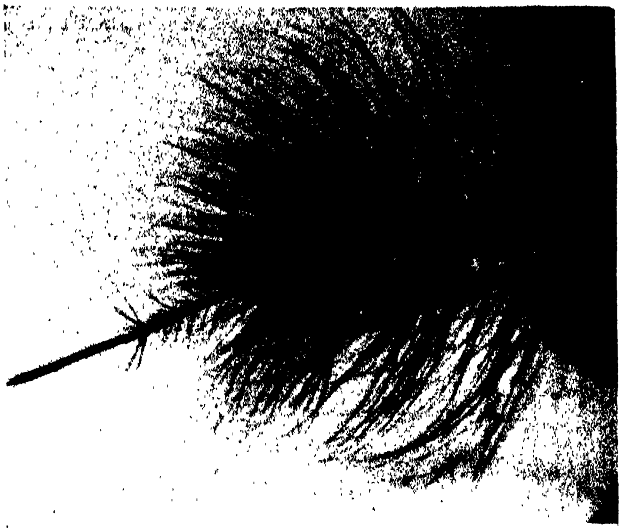
usually found to have very feathery antennae clothed with sensitive bristles and hairs of various kinds, while those of the female moth are of comparatively simple structure; and it is maintained by some authorities that the male moths can by means of their complex, feathery feelers scent from afar the object of their search. There may, however, be a quite different explanation, as I will here endeavour to show.

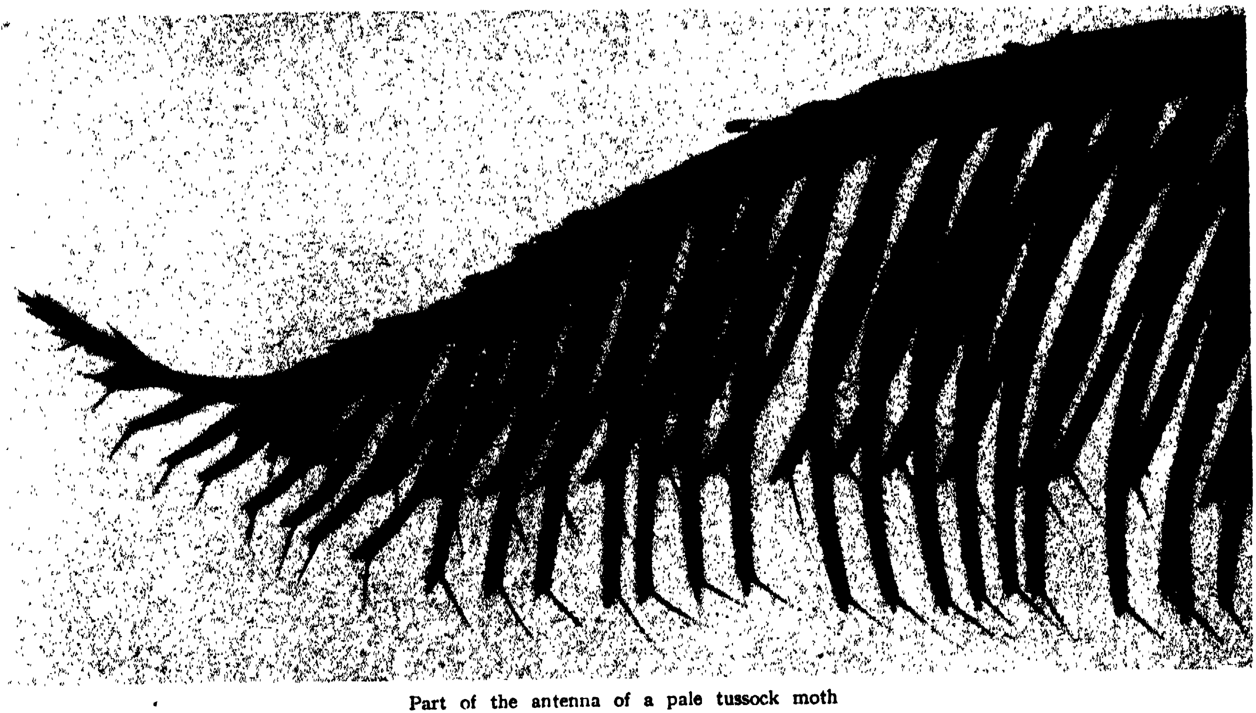
If smell is the means of attraction, it is a sense of smell quite beyond human comprehension, for to us "smell" means odour that is perceptible to human senses; yet the smell of the female moth is supposed to attract male moths from miles around, up or down wind indifferently. Henri Fabre, at the beginning of the century, made experiments with various moth species, and he found that when certain female moths were placed under a bell glass cover sealed with putty, or put in a well-closed box, they no longer attracted the males, and on his experiments is largely based the evidence of those who support the scent theory.

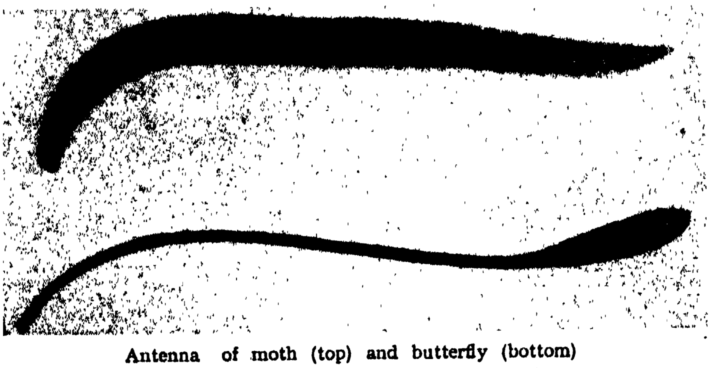
Fabre also found that objects against which the female moths had rested would, likewise, for some time afterwards, attract the male moths; which seemed a further proof that smell was the agent of attraction. Fabre endeavoured to mask this subtle smell with naphthaline, sulphuretted hydrogen, oil of lavender, paraffin, and so on, until his study had "become an odious laboratory," but still male moths continued to come as frequently as ever, and he then found that he could not believe that his own experiments had proved that it was smell. He realized that they left much unexplained, and finally he asked: "But what is materially emitted? Nothing according to our sense of smell. And this nothing is supposed to saturate an immense circle several miles in radius with its molecules! However divisible matter may be, the mind refuses to accept such conclusions." Then, as a solution of the mystery, he added: "It does not emit molecules: it vibrates, it sets in motion waves capable of spreading to distances incompatible with a real diffusion of matter."

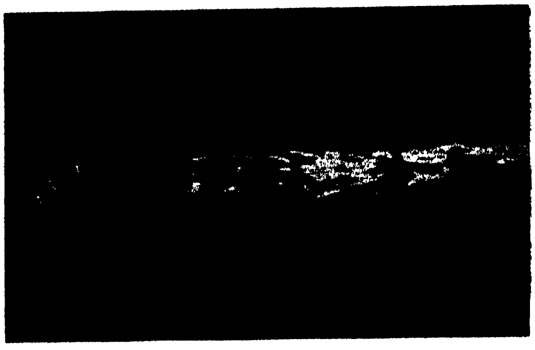
At that time Röntgen rays, or X-rays, had just been discovered, and our present knowledge of rays and electro-magnetic vibrations had scarcely commenced, yet by some marvellous intuition Fabre's great mind had surely provided the key to the solution of the mystery. If we apply the theory of wave emanation, and suppose that the female moths "broadcast"


Antennae and mouth of ground beetle


Antennae of male gnat

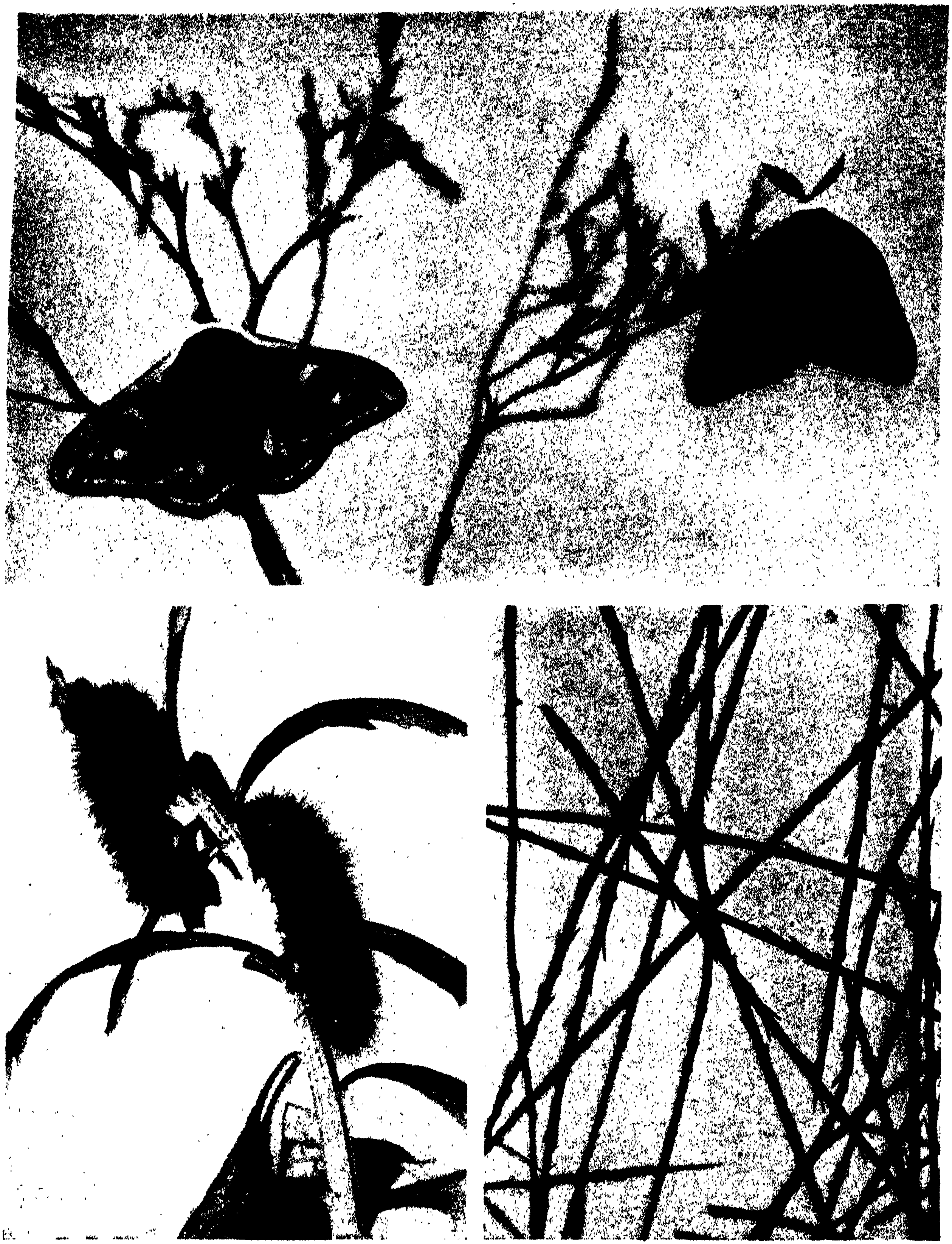

Part of the antenna of a pale tussock moth


Antenna of moth (top) and butterfly (bottom)


Tip of antenna of tortoiseshell butterfly

AERIALS FOR INSECT RADIO? INTENSELY SENSITIVE ANTENNAE OF VARYING FORMS

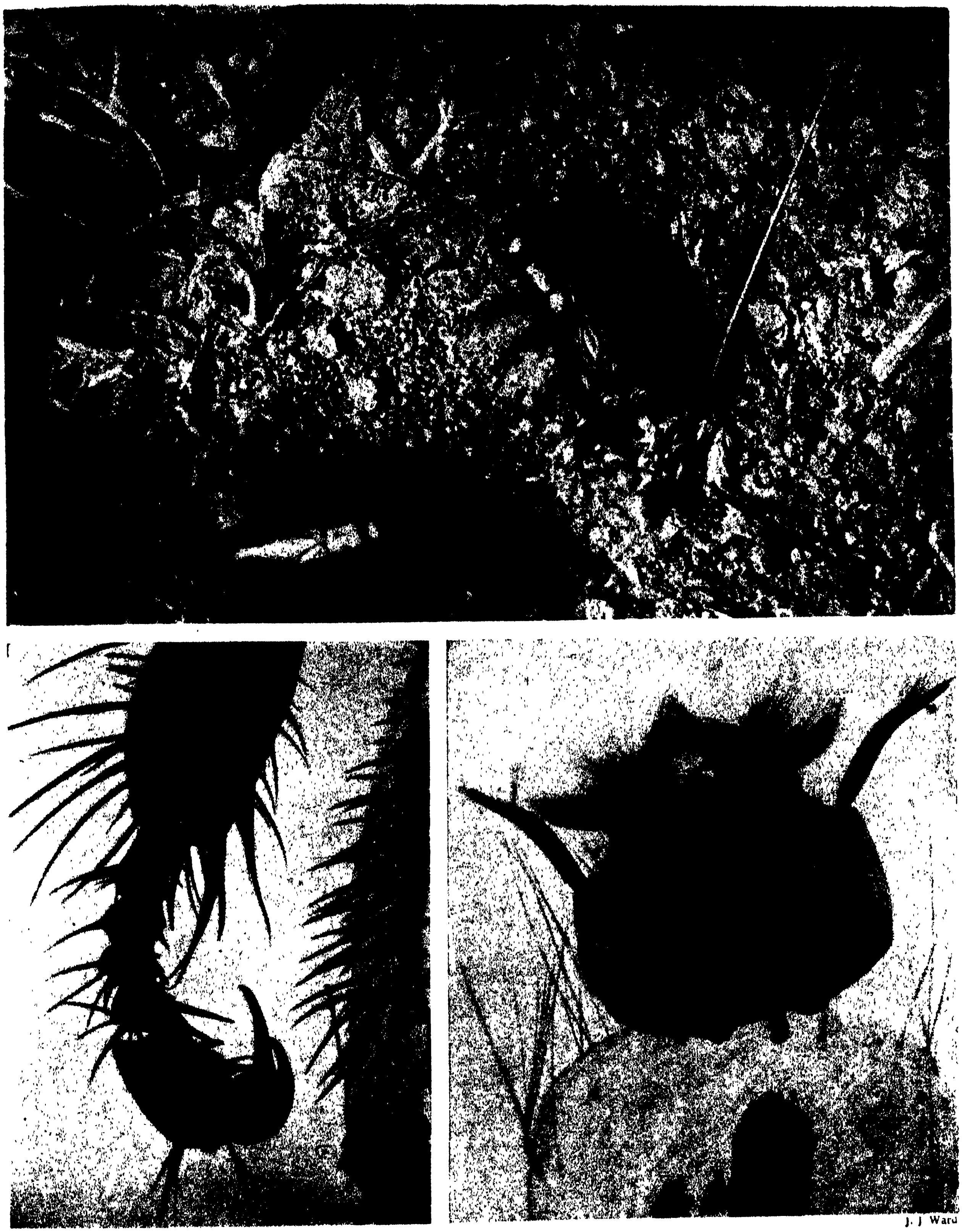
In the antennae or feelers of insects we have organs of remarkable sensitiveness, and, indeed, it is not yet certain what the limits of that sensitiveness may be. It seems possible that they may serve to convey to the insect what corresponds in man to the senses of touch, taste and smell, and perhaps the perceptive qualities of these delicate organs may be even capable of receiving some stimuli on a par with the waves that actuate a "wireless" set, and in the same way. These micro-photographs by J. J. Ward show a variety of patterns.



J. J Ward

SENSITIVE HAIRS OF THE "WOOLLY BEAR" AND THE MOTH IT EVENTUALLY BECOMES

Familiar in most gardens during the summer, the "woolly bear" caterpillar (bottom) may sometimes be seen proceeding along the surface of the garden path in a series of rapid undulations of its hairy back. These hairs, when magnified (bottom right), will be found to possess barbed edges, and they are very sensitive. The lightest touch will make the caterpillar shrink. The top photograph shows, on the left, a female and, on the right, a male emperor moth. These are the creatures into which the "woolly bears" grow.



J. J Ward

BRISTLES, HAIRS AND ANTENNAE THAT SERVE WONDROUS PURPOSES FOR THEIR OWNERS

Sheep ticks get in touch with their hosts by waiting on grass stems till a sheep walks by. The bristles on the tick's leg (bottom left) warn it that something has brushed against it, and the formidable grappling-hook of the foot comes into play. This photograph, and the one to the right of it, showing a gnat larva's head are greatly magnified. The gnat larva is equipped with hairs which pass currents of water to the mouth, which thus extracts nutriment. Above are two crickets getting their bearings by means of their antennae.

for a mate, it appears to offer at once a clear explanation of the whole of the phenomena. Even the fact of the male moths visiting objects on which the female moths have rested (one of the chief planks of the scent theory) is then no longer a puzzle, for it is the property of rays to penetrate, and often to leave a record behind.

J. J Ward

HEADS OF PUSS MOTH AND UNDERWING MOTH

In the puss moths both sexes have antennae that are bipectinated, that is, resembling two combs, laid back to back. The " teeth " of these combs are much larger in the male than in the female. Here we see a male with his antennae. Above is a full-face photograph of a broad-bordered underwing. Both photographs are magnified.

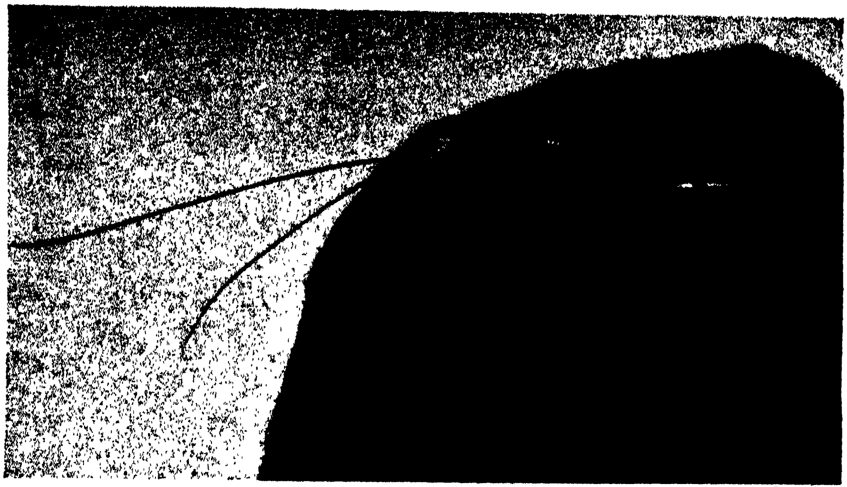
The actinic, or ultra-violet, rays at the end of the known light spectrum, although invisible to our eyes, we know will affect our photographic plates. During the War period a street novelty was sold in the form of buttons coated with a paste made from sulphides of metals, as calcium, barium, and strontium, which, on exposure to daylight, would, at night, give out their absorbed light rays. Even a rock after exposure to sunlight will for hours afterwards give out invisible heat rays. These are rays of which we have knowledge, but those that are probably used by the delicate sensory organs of insects are far beyond detection by means of man's coarse instruments. I suggest that they are probably of very short wave-length, nearly approaching those of visible light—round about one fifty-thousandth of an inch—which, of course, are very rapid when compared with man's wireless waves of from hundreds of yards to some miles in length.

Recent American experiments in the making of a new transmitting valve for short wave-lengths of approximately ten centimetres have shown that the operators engaged on the work suffered with pains in their limbs, and that rats kept in a cage near the transmitting aerial became greatly excited. That at least indicates that animals can be influenced with such short waves.

Fabre's experiments with the moths under a sealed glass and in a tightly closed box when considered from the wave emanation aspect might easily fail. The moth itself may not have been " broadcasting " at the actual time of the experiment for the moth can instantly shut off the wave, as she does when she has found her mate. Also, the fact of interference, and shutting off the air supply, might, with her delicate senses, readily bring about that very result. Indeed, Fabre himself, although he could not understand why, recorded of the moth that: " Taken from her couch and placed elsewhere, the female loses her attraction for the time and becomes an object of indifference." In any case, Fabre shows clearly enough that the phenomena he had witnessed could not be accounted for by an air-borne scent; he fully realized that something still remained unexplained.

That an insect should produce an invisible ray is quite a possibility, for there are insects that emit light rays—as the familiar British glow-worm, and the fire-flies of tropical America, which, like the glow-worms, are really beetles; there are also tropical may-flies that produce light. And this brings us to a strange connection. Male glow-worms, of course, seek their mates by the sense of sight, the bright light of the female attracting them from afar. However, innumerable males are drawn from their course by artificial lights, and where such lights are exposed these amorous males quickly meet with their destruction. Here we have an instance of what in wireless is known as " interference "—a stronger transmitting station superimposing on a weaker one with most unfortunate results for the owner of the " set " interfered with.

Strange to relate, we find exactly the same thing taking place with regard to moths; the moth and the candle flame have become proverbial. The moth in "tuning-in" to the invisible wave that is transmitted by its mate is likewise drawn from his course by artificial lights; surely the explanation is because he is using a wave-length very close to that of visible light, exactly as in the case of the male glow-worm. Similarly, we have beetles, such as the cockchafer, which do not emit light but which, like the moths, fly to the lights, and it is significant that the antennae of the male cockchafer are of a very complex structure, being formed of a series of leaf-like plates bearing sensitive bristles; they are quite unlike the ordinary eleven-jointed feelers of most beetles. The scent theorist entirely ignores these allied phenomena when he proclaims that an ordinary air-borne odour as human senses perceive it is the means of attraction.



J J Ward

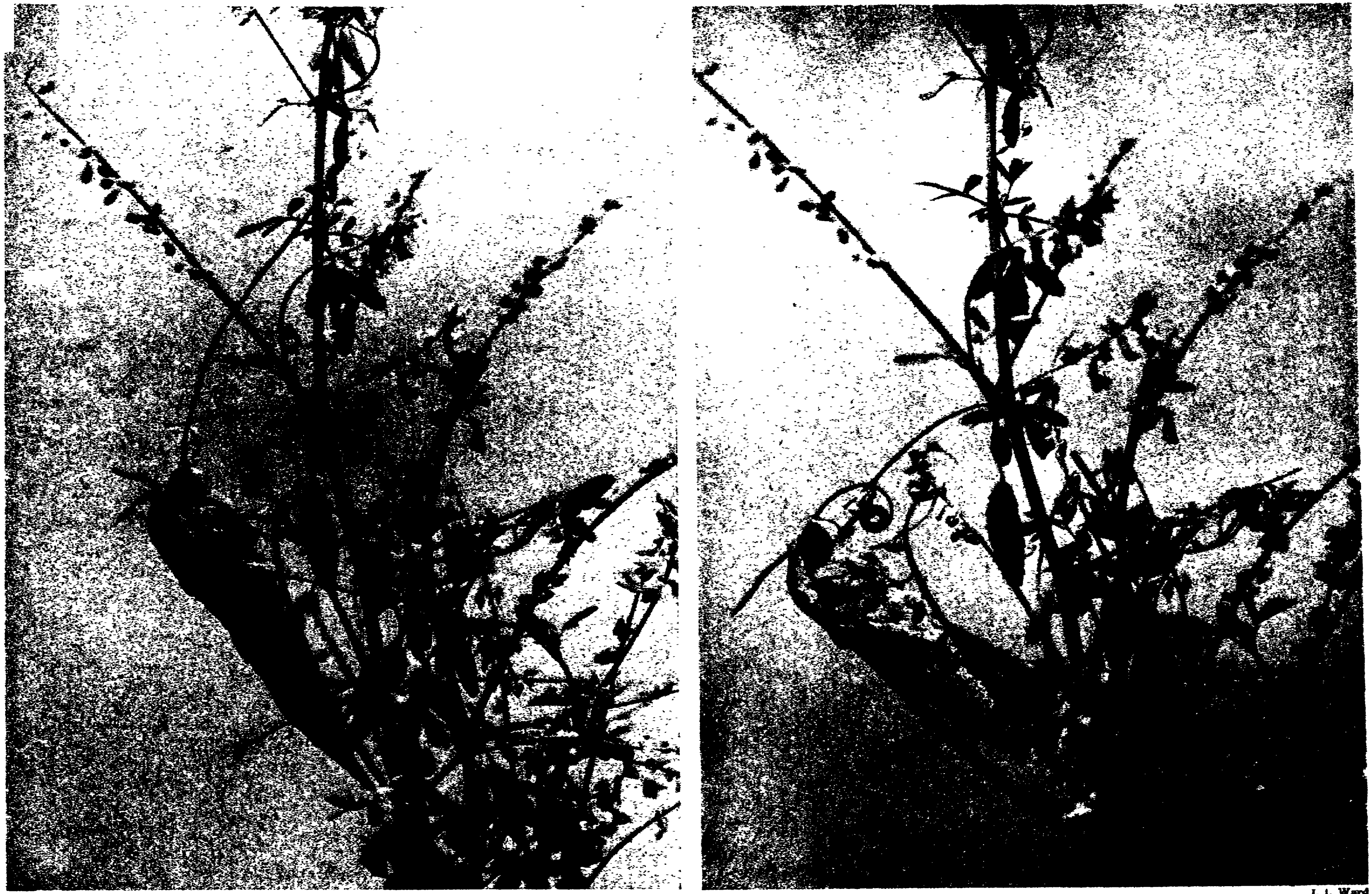
HOUSE CRICKET AND THE "EAR" ON ITS LEG

House-crickets hear with a special organ upon the foreleg (bottom). This is an oval opening, and by its means the house-cricket (top) hears the chirping of its mate. To human senses the sound is most deceptive, and seems endowed with some quality as of ventriloquism, so that it appears to come from some other quarter than the real one. But the mate is not deceived.

THERE is another strange phenomenon with regard to moths. The collector goes out into the woods on an ideal night for making captures, when there is a warm thundery atmosphere, and it may even be raining at the time; a bright moonlight night is generally hopeless. Sometimes the ideal night yields nothing, while perhaps the next night, which may be cold with moonlight, will provide abundant specimens. With the light as a lure to effect his captures the same thing happens; on what appears to be a most favourable night nothing is attracted, while another night when conditions seem altogether unsuitable there is a swarm of moths of many species round every lamp. Here, surely, we are up against what in wireless parlance is known as "atmospherics." I suggest that the moths are using a miniature long-distance transmission. All who have wireless sets for long-distance reception will know full well that on some nights the transmission comes over quite well, while on other nights it is hopelessly bad.

When we examine the antennae of the male moths who respond to the "wireless" calls of their mates, we find that each species has an entirely different "wireless set." That must be so, for their instruments are not provided with a series of knobs to tune in to different stations. Their sensory organs necessarily have to be adjusted solely for the wave-length used by the female of their species.

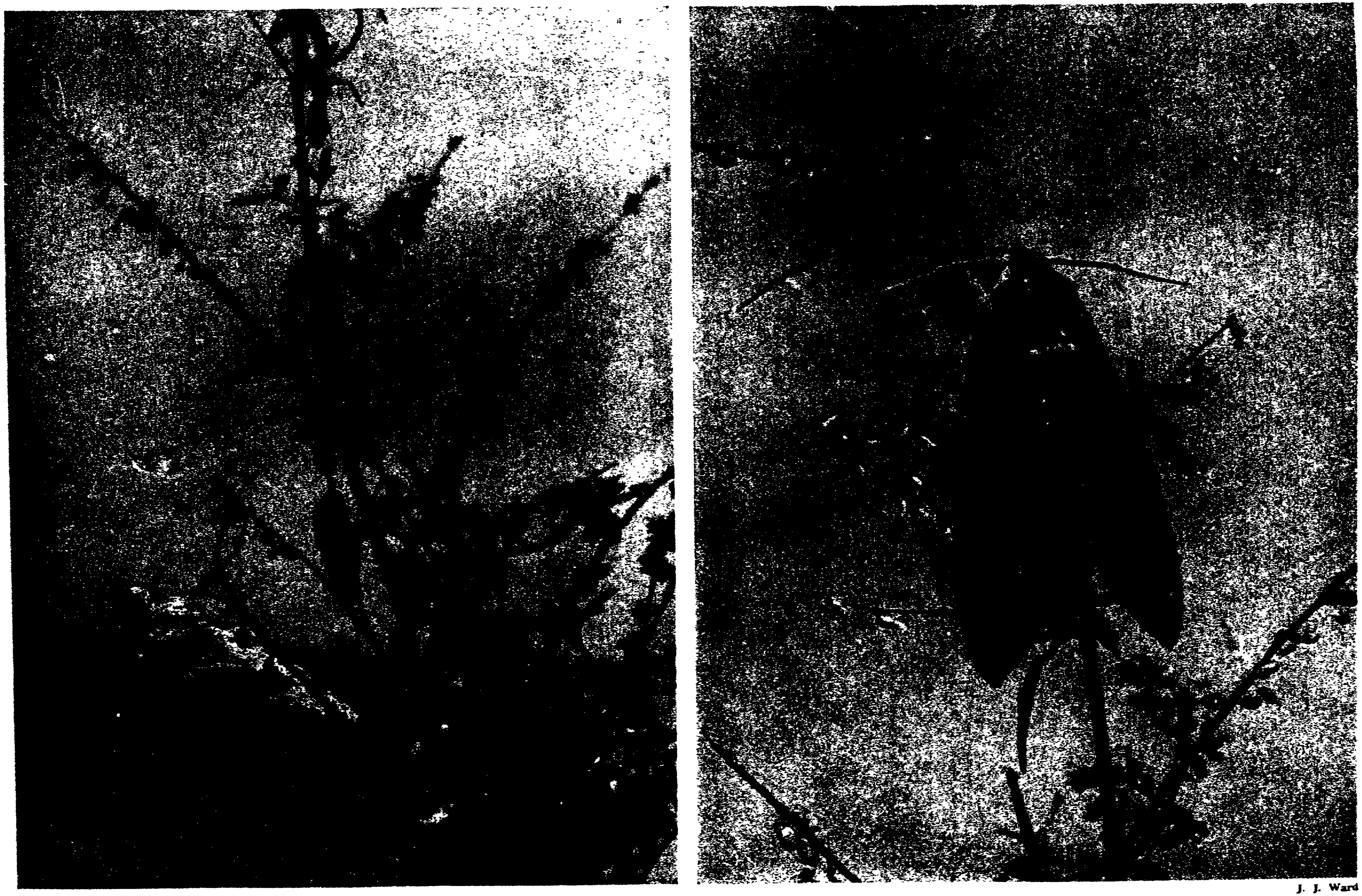
From the evidence here adduced, surely there is a case for showing that the moth's sensory feelers are organs specialised for receiving delicate radio-vibrations, probably of the nature of the infra-red, or heat, rays, which in the wave spectrum come just below those of visible light. The value of such organs as a means of finding a mate is demonstrated in a very curious fashion. It has proved so effectual that we find the wings of many of the female moths that "broadcast" have become more or less atrophied and in some species they have entirely disappeared. Here, too, it is well to remember that the female glow-worm, that emits light, is also wingless, while the males have good flying wings, exactly as in the case of the moths. Some species have gone even further and lost the use of their legs, and are without mouth-parts, so that they cannot fly, walk, or feed. It is therefore essential that no time whatever should be lost in finding their mates.



J. J. Ward

OPERATIONS OF UNCOILING AND RECOILING THE AMAZING PROBOSCIS OF THE CONVOLVULUS HAWK MOTH

So huge is the proboscis of the convolvulus hawk moth that, in the chrysalis stage, the tongue case forms a projection at one end which rather resembles the handle of an earthenware jug. The suggestion is further strengthened by the fact that the chrysalis is of a brownish-red tint. When the moth crawls out of its case the proboscis is found to be about twice as long as the whole length of the creature's body. This enormous organ is kept coiled up like the mainspring of a watch, and we see it here in the process of being uncoiled (left) and recoiled (right) after the feeding process has been finished. These photographs are, of course, both considerably magnified.



J. J. Ward

CONVOLVULUS HAWK MOTH AND ITS EXTRAORDINARILY LENGTHY PROBOSCIS

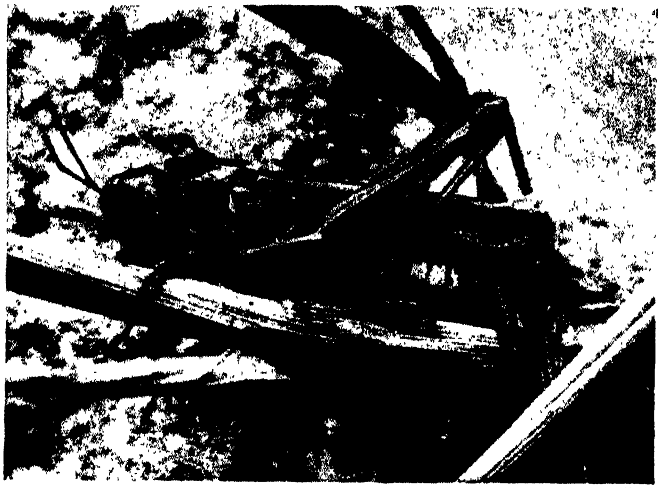
In the left hand of these two photographs, which are both much magnified, we see how the convolvulus hawk moth withdraws its tremendous proboscis into the lower part of its head. This is the position in which it carries the proboscis. When the moth arrives opposite a flower the coils are unwound and the whole affair thrust into the heart of the flower to sip the nectar that lies there. It especially visits plants with long tubercles, such as the tobacco plant and the petunia, and does not alight but feeds while hovering. It commences operations at dusk and continues well on into the night. The right-hand illustration shows the moth at rest upon a plant.

The variations in the antennae of the various orders of insects are really amazing, and they doubtless serve very different functions in each type. Butterflies do not exhibit any of the phenomena referred to above in the case of the moths, and their antennal functions are somewhat of a puzzle. It is possible that they have something to do with the locating of the particular food plants required by their caterpillar offspring ; for the butterfly itself feeds entirely on the fluid sweets from the flowers, and cannot have the very least idea of the meaning of green leaf food.

That insects do possess a very highly-developed sense of smell nobody can doubt. One may witness the speedy arrival of the wasp the moment the sweets are placed on the dining-room table ; or the advent of the blowfly eager to deposit its eggs on a dead or injured animal ; or the early visits to the crocus blooms of tortoise-shell and brimstone butterflies, although it may be a day in early March when perhaps an hour before those same insects were snug and dormant in their winter hibernating places. Possibly, too, scent plays a part in the courtship of many of our common butterflies, for when we see them fluttering around each other in mid-air it is probable that the male is wafting sweet odours to attract the lady of his species ; for on his wings are peculiar scales known as plumules, or androconia, which are associated with scent cells, producing such perfumes as lemon, sweet briar, violet, and other flowery essences quite perceptible to the human olfactory organs when the scales of the butterfly are disturbed.

Recent experiments have shown that honey bees have a similar sense of smell to that of man so far as it is associated with floral perfumes. Also that they can absorb a particular food scent, and, in the hive, by dancing movements, convey that scent to the other bees so that they can go out quite independently to seek that food supply.

If we turn to the sense of hearing, we again find the antennae playing a part. Swarms of gnats have been observed to show a sympathetic jerky movement with the whistling of a railway engine a mile away. If we think of the shrill piping note of the female gnat and mosquito, we begin to understand that probably the distant sound of the engine's whistle may approach the gnat's range of sound. The male gnat has beautiful feathery antennae, and Mayer, who made a series of experiments, says : " The hairs on the antennae of the male gnat vibrate in unison with the notes of a tuning-fork within the range of sounds emitted by the female. The longer hairs vibrate sympathetically with the graver notes, and the shorter with the higher ones." So that insects may be said to "hear," or at any rate perceive, sound, although they have no apparent "ears."

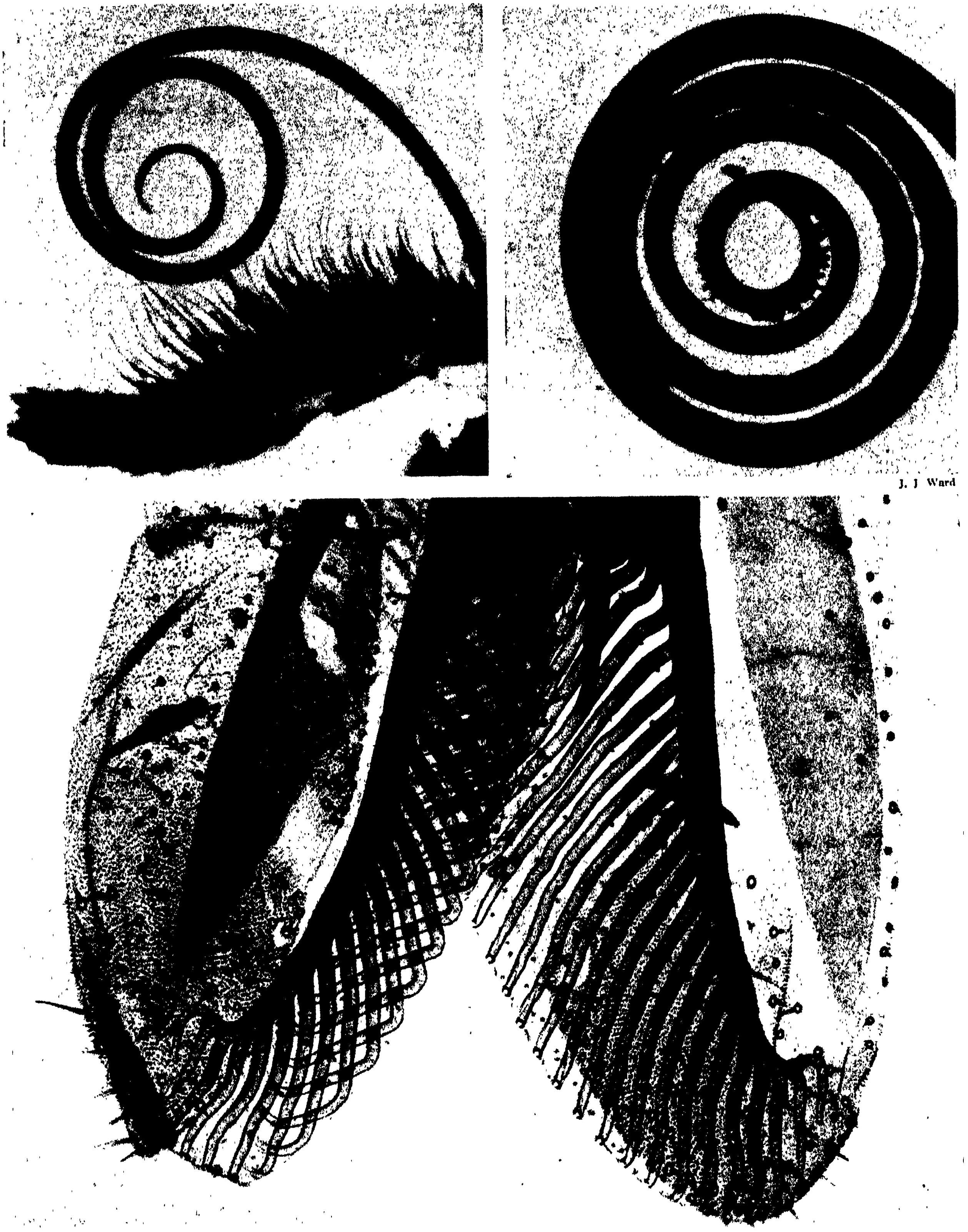


J. J. Ward

STRANGE EARS AND EYES

The short-horned grasshopper (bottom) has its " ears " in the first ring of its body, near the thorax, and by this means hears the stridulating of its mate. Above is a queen wasp's head with two kinds of eyes, single and compound. The single eyes are called ocelli

We should remember, too, that probably they make and hear sounds quite beyond man's sense of hearing ; ordinary noises have little or no effect upon them, but when imitations of their own sound productions have been made with suitable instruments they have been shown to be both excited and alarmed. Some insects, however, have ears similar in mechanism to our own, and such ears may be found in various parts of their body and limbs. Crickets and long-horned grasshoppers, for example, have their ears situated in their fore-legs, just below the " knee " ; while in the short-horned grasshoppers a different arrangement prevails, their ears being found one at each side of the first ring of the abdomen, close to the thorax. The chirping of the male cricket attracts the female, and it has been demonstrated that when a chirping male has been placed against the mouthpiece of a telephone a female cricket in another room was at once attracted and made her way rapidly to the telephone in response to his call made in this quite unusual way. Of the sense of sight little need be written here, as



J. J Ward

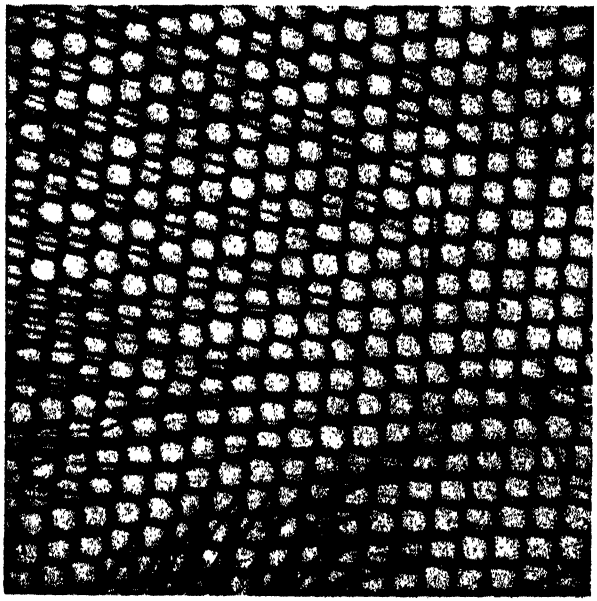
E. A. Botting

FORMS OF PROBOSCIS POSSESSED BY DRONE FLY AND BUTTERFLY

The proboscis, or trunk, of insects is the organ by means of which food is conveyed to the mouth. Below is the proboscis of a drone fly much enlarged, while the top photographs show (left) the proboscis of a butterfly with the mouth palps and its special sensitive hairs and (right) a butterfly proboscis more highly magnified to show details. The proboscis consists of two tubes which are joined by interlocking hairs. This join makes a third tube, between the others, and it is through this that the nectar from the flower is sucked. The outer tubes supply air.

an account of the ocelli, or single eyes, and the compound eyes of insects has previously been given in this work (pages 192—204). It is interesting to learn, however, that some recent experiments by a German biologist, Professor von Frisch, have shown that the ultra-violet rays, invisible to the mechanism of the human eye, but which, as previously mentioned, affect a photographic plate, are visible to honey bees, although of what colour they represent to them we have no possible conception. Also, that while the bees could appreciate the ultra-violet rays, they failed at the other side of the light spectrum; they could not recognize red at all; red and black were to them of equivalent values. Surely an interesting fact when we remember that the same applies to a sensitive photographic plate. It may also account for the absence of black and pure red flowers in temperate climes. In the tropics a few spectral, or pure red, flowers occur, and it has been found that these are pollinated by birds. It is the green, blue, violet and ultra-violet side of the spectrum that attracts the bees; the red side is to them a blank, just as the ultra-violet is to us.

Finally, there is the sense of taste. Groups of cells associated with taste, in the higher animals are in insects represented by wonderful tongues with very complex sensory functions specialised for fluid food.



J. J. Ward

FLIES' EYES IN DETAIL

Below are a few of the four thousand or so of facets which go to make up one of the compound eyes of the house fly. A picture of the fly's head with the complete eyes is given on page 192. Above we have the compound eye of the blow fly in section. Each facet is connected with the optic nerve centre.

Chapter LXXXV

The Marvellous Angler-Fishes of the Ocean Depths

By C. Tate Regan, F.R.S.

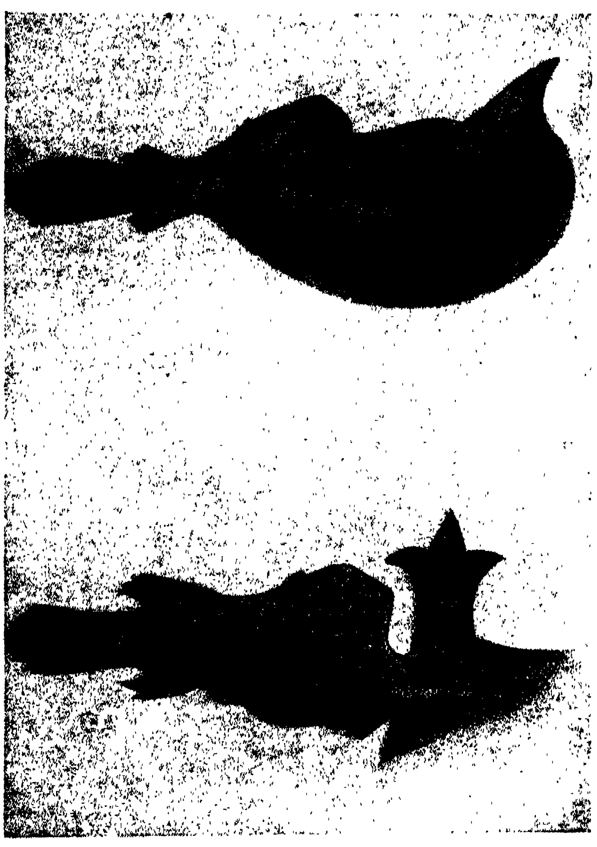
Director, The Natural History Museum, South Kensington

It is believed that no light rays penetrate the ocean to a depth of more than 250 fathoms, yet at this depth, and in the still deeper waters, down to a mile or more below the surface, there is a great diversity of living creatures.

The fishes of these ocean depths, that pass their lives in complete darkness, differ in colour from those that live at the surface or in the coastal waters; they are generally uniformly blackish, without that gradation from dark on the back to pale below which is characteristic of fishes that live in the light, and counteracts its effect. Many of these fishes, but not all, are provided with luminous organs. In one group, known as the Stomiatoids, there is a double series of small luminous organs along each side of the body; these must look like the shining port-holes of a ship in the night, and may help the members of a shoal to keep in touch with each other; a larger organ is placed in a pocket just behind the eye, and is so arranged that the luminous surface may be turned inwards into the pocket, or may be exposed, giving light for the eye to see; finally, there are luminous appendages — barbels — depending from the chin, which may be used to attract prey.

All the fishes of the ocean depths are carnivorous, living on each other, or on the prawns and other sorts of small creatures that inhabit these regions. In the absence of light there is no plant life, and one wonders what the primary source of food may be. It is generally accepted that this must be organic matter falling from the upper layers, and that the minute floating plants of the surface are the ultimate basis of the life of the fishes of the depths. This seems almost incredible, but is not more wonderful than that the small amount of carbon dioxide in the air should supply the carbon for the growth of trees.

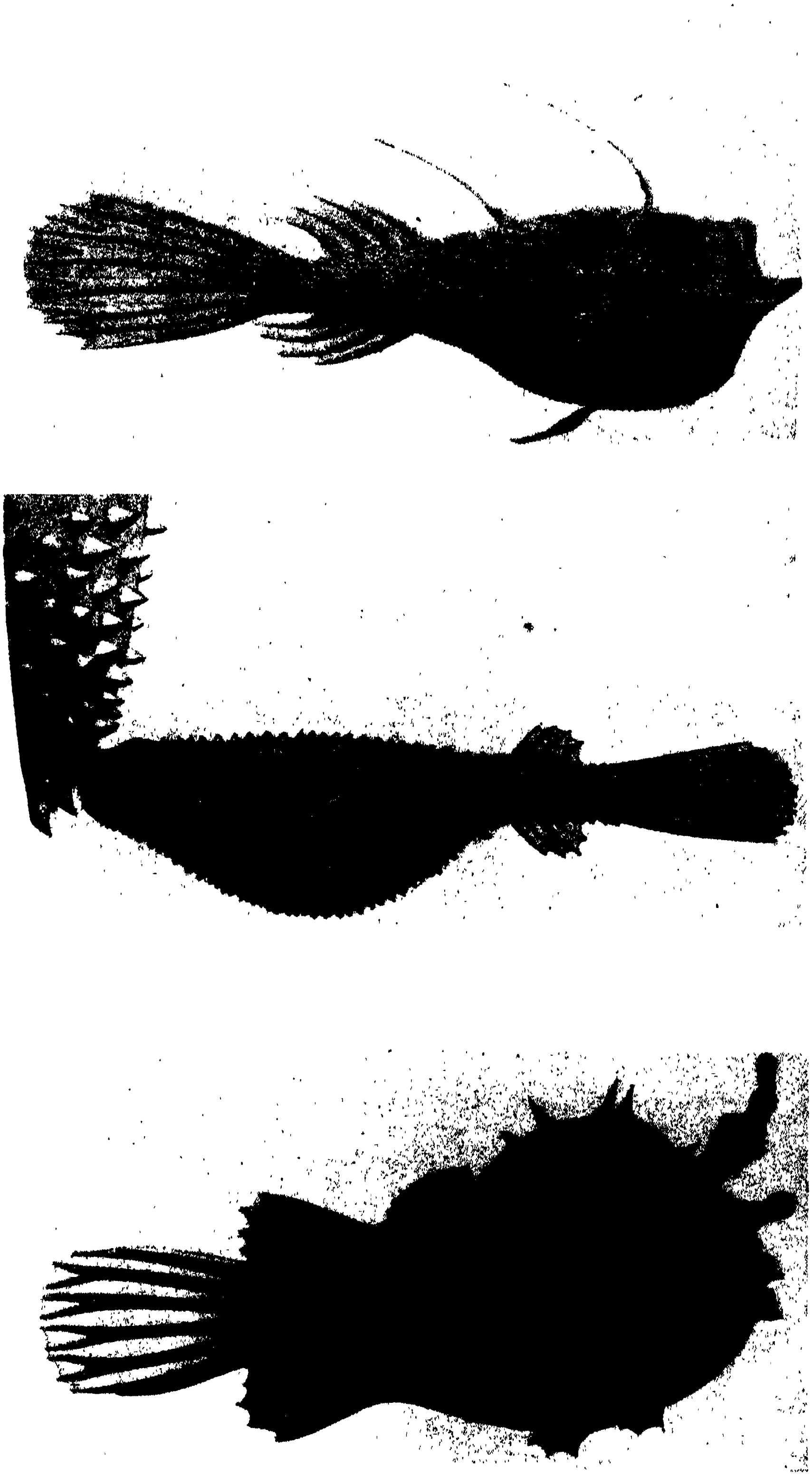
The pressure of the water at depths of 200 fathoms or more is enormous, but fishes that live at these depths appear to need no structural modifications to enable them to withstand it. Moreover, if the nets in which they are caught are brought slowly to the surface, so that the alteration of pressure is gradual, they arrive intact and in perfect condition. What would happen if they were hauled up quickly is shown at Madeira, where there is a fishery for wreck-fish (*Polyprion*) by long baited lines fished on the bottom at about 200 fathoms; as the hooked fish ascend the gases in them are liberated, they gather speed and shoot out of the water, considerably distended and with eyes protruding.



LITTLE CANNIBALS OF THE DEEP

Most of the angler fish are very small indeed, and of the two here the one below, *Edriolychnus*, is seen four times its natural size and the one above, *Photocorynus*, five times its real dimensions. The illustrations are given by courtesy of the British Museum (N.H.)

One of the most interesting groups of fishes that live in the ocean depths is that of the anglers, so named because the first ray of the dorsal fin is placed on the head and is modified into a line and bait. The anglers of the coastal waters generally lie in wait for their prey at the bottom, and their coloration harmonises with that of the ground on which they lie, or the rocks and weeds among which they lurk. Their bait is a skinny flap or a tassel at the end of the line, and is waved about to attract other fishes. The anglers of the ocean float about in the darkness of the depths, they are uniformly blackish, and at the end of their line is a bulb-like swelling that contains a gland with a luminous secretion; there is some evidence that the light can be switched on and off; when turned on it acts as a lure, which is not meant to be seized but to bring other fishes near the angler's mouth



British Museum (Natural History)

FEMALE FISH WHOSE MATES ARE MERE PARASITES

Belonging to the family of the Ceratoids, or angler fishes, are some sixty known species, of which we have two here. *Photocorynus spiniceps* (bottom), enlarged to nearly twice natural size and *Ceratias holboelli* (centre and top). The males are mere parasites, attached to the females for life. The centre illustration shows a male, natural size, and above we see it with its female.

The oceanic anglers are distinguished not only by their black colour and the luminous lure, but by other peculiarities; they form a group apart, known as the Ceratioids. This group contains some sixty different known species, some of which are figured in these pages.

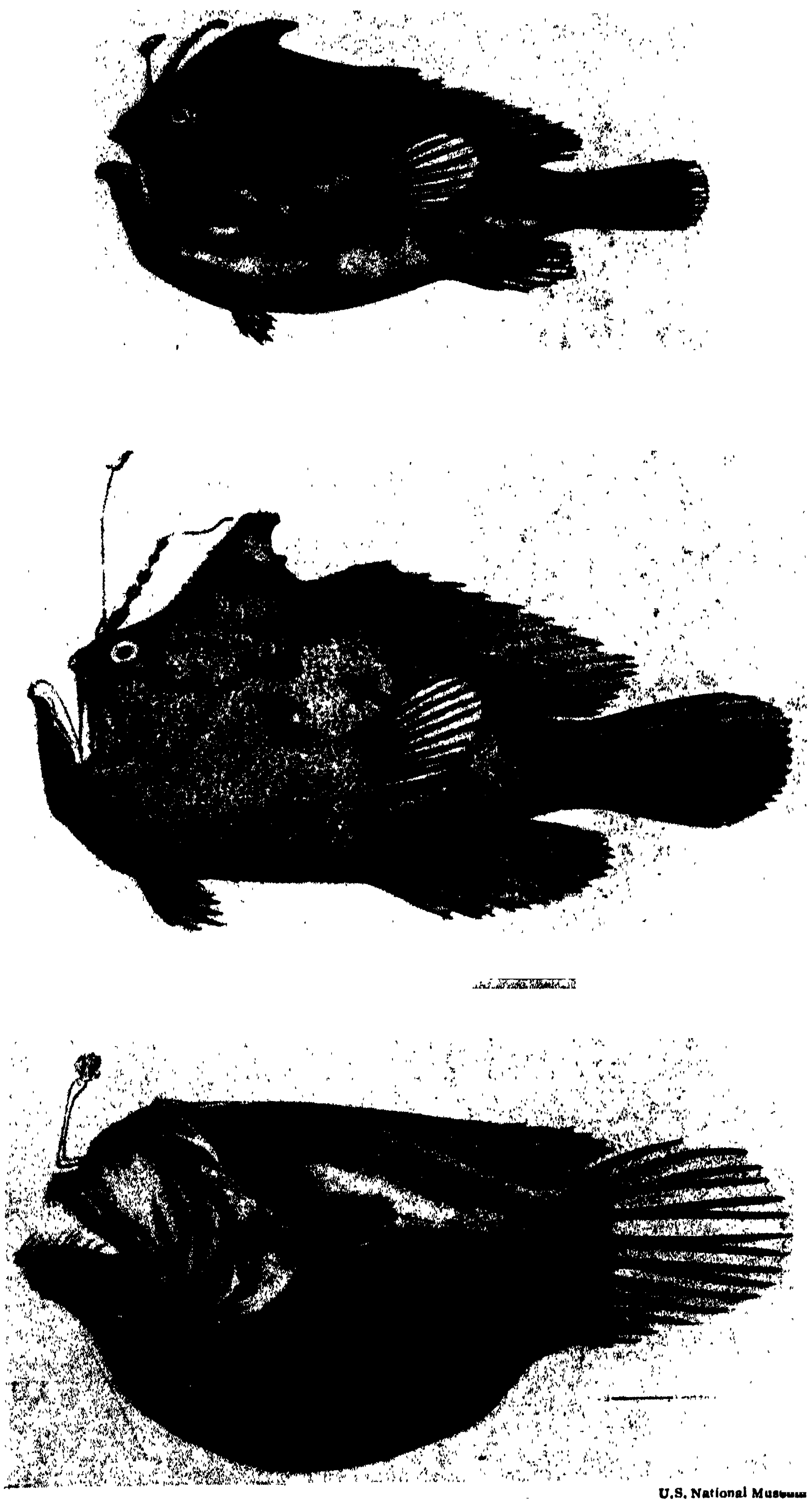
Most of these oceanic anglers have enormous mouths, provided with sharp teeth that are depressible, allowing their victims an easy passage inwards, but becoming erect and holding if one attempts to escape. They are also remarkably distensible, swallowing fishes many times their own size and simply stretching to accommodate them. Two genera, Melanocetus and Linophryne, are particularly noteworthy in this connexion, for specimens have been found at the surface of the ocean, far away from their home in the depths, alive but helpless, swollen out by the much larger fishes they have swallowed. Each had seized her prey by the tail, and then held on—probably she was unable to let go—while the victim swam upwards. Every time he paused the angler would take in a little more of him, but by the time his struggles ceased he had brought his captor to the top, in no condition to make an effort to get down again. One Melanocetus managed successfully to swallow a large fish without being brought to the surface, and had just begun to digest it when she saw a bait on a hook, took it, and was caught; such greediness deserved no better fate, and she is now preserved in spirit in the Natural History Museum at South Kensington.

In some of the oceanic anglers the lure appears like a lantern placed directly on the head just above the mouth, in others it is at the end of a long and slender line and is no doubt moved about to imitate the swimming movements of a small luminous animal. The line, like other fin-rays, is attached to a bony support, and in some species this bone projects from the head, becomes long and flexible, and forms a rod. In one genus (*Lasiognathus*) the line ends in a triangle of hooks, and this fish, with rod, line, bait and hooks is certainly a complete angler, and should, perhaps, have been named after Izaak Walton. Only one specimen is known, and as the stomach is empty we cannot say what sort of prey is hooked.

In the preceding account I have once or twice referred to a fish as " she " and this is of set purpose, for all the Ceratioids that swim freely in the ocean are females, and the only males known are dwarfs parasitic on the females. Males are rare and so far have been seen in only three genera, Ceratias, Photocorynus and Edriolychnus.

Ceratias is remarkable for the spiny skin and the very long and slender rod bearing a short line. The fishes of this genus grow to a larger size than others of the group, and, when large, find insufficient food in the open ocean and make for the banks where cod abound. Thus, two examples, each about forty inches long, have been taken by trawlers to the south of Iceland; one had two males, each three inches long, attached close together on one side of her abdomen, the other had a single male, measuring four inches long, which was placed in the mid-ventral line a little behind the head.

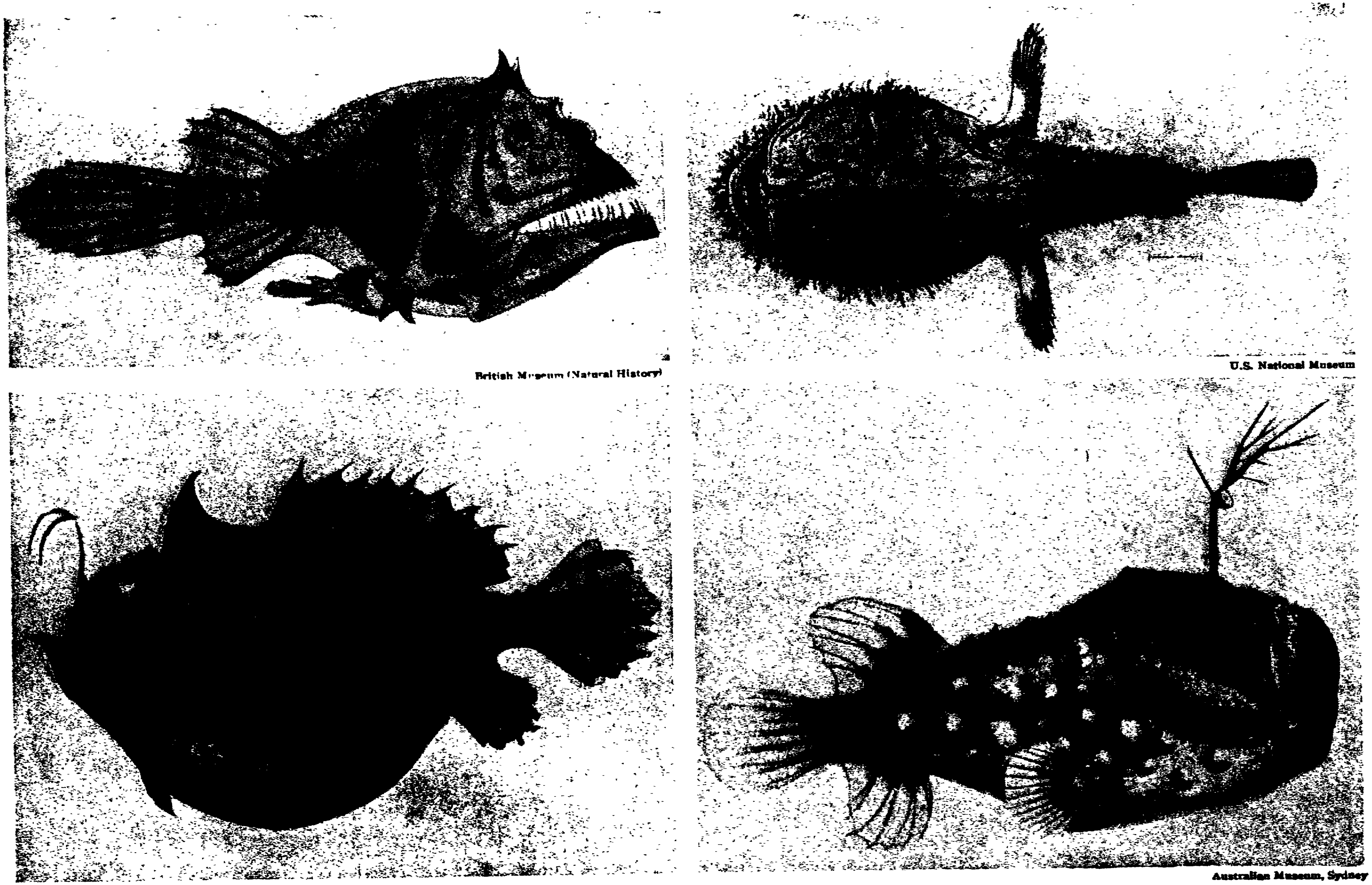
The other females with males are quite small, less than three inches long; one was caught in the Atlantic, the other in the Gulf of Panama. The males are adults, but one, placed on the top of his wife's head, just above her right eye, is only two-fifths of an inch long, the other, spending his life upside down attached to the side of his mate's head, measures three-fifths of an inch. Thus in weight the wives are about



U.S. National Museum

MINUTE MONSTERS FROM THREE HUNDRED FATHOMS DOWN

The small lines in the above photographs indicate the actual size in life of the fish shown. It is only by enlargement that it is possible to get a convincing illustration of these tiny ogres of the deep which, one might imagine, were huge things. But they make up for their size by having widely distendible stomachs in which they can accommodate fish their own size.



British Museum (Natural History)

U.S. National Museum

Australian Museum, Sydney

UGLY ANGLER FISH WHICH HAVE SHORT BODIES AND VERY LONG NAMES

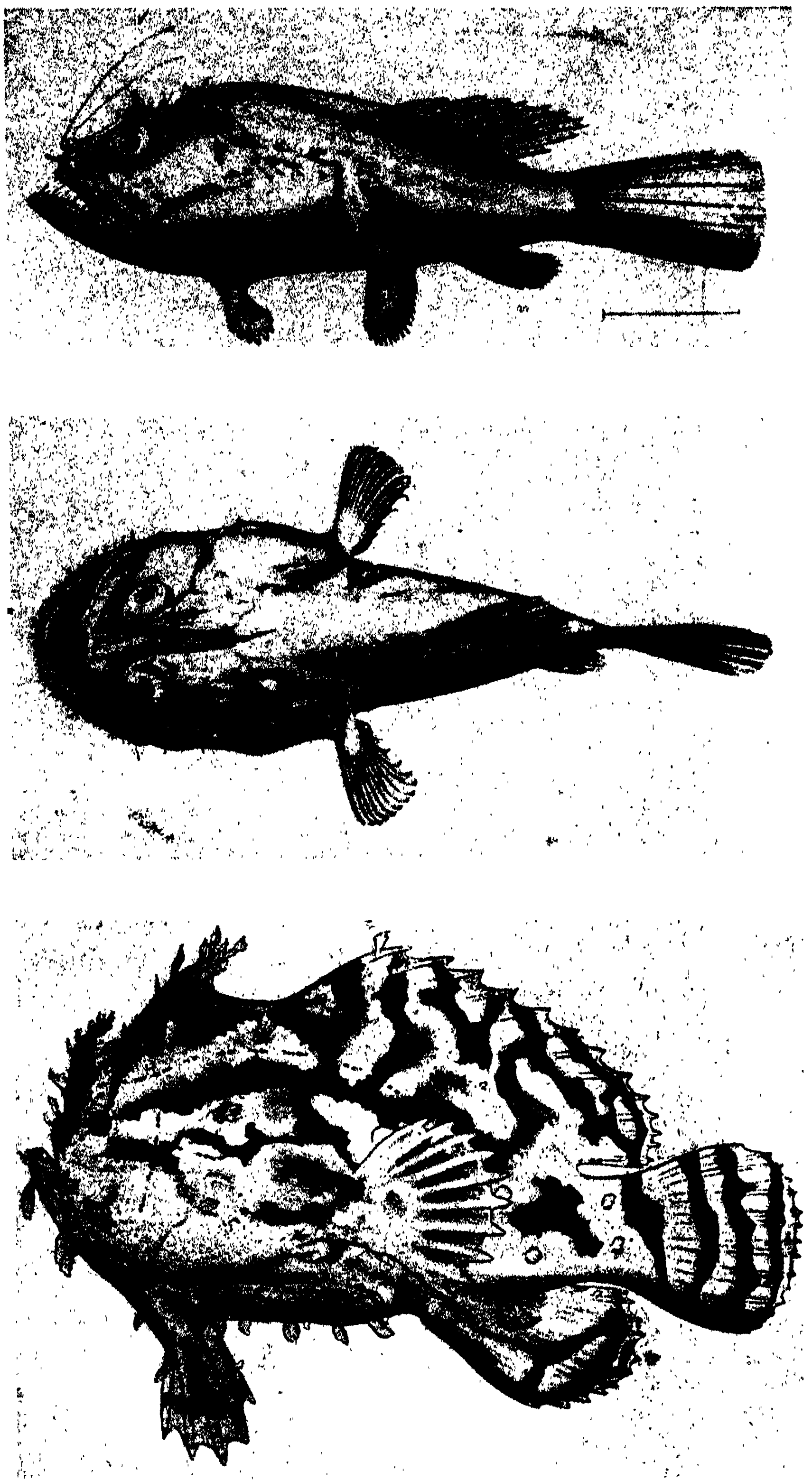
Angler fish, for the most part, have names almost as fearsome as their appearance. In the waters of the Middle Harbour at Sydney swims *Antennarius striatus* (bottom left). It is of a light brown, and is marked with irregular blackish stripes and, so attired, matches the seaweeds in which it lurks. Its food consists of prawns and small fish, and some of the latter it can swallow although they are much the same size as the swallower. The other fish seen above are *Aegoeonichthys appelii* (bottom right); *Edriolychnus schmidti* (top left), and *Lophiodes olivaceus* (top right), alarming and impressive both in appearance and nomenclature. All of them entice their prey by angling for it with a special attachment on the head or back.

one hundred to two thousand times as big as their husbands.

The males are permanently joined to the females. In Ceratias and Photocorynus outgrowths in front of the mouth of the male unite with a soft projection from the skin of the female, but in Edriolychnus the main connection is inside the mouth of the male. Other fishes that live in the darkness of the ocean depths pursue their prey actively and swim in companies; but the anglers are sluggish, they float about waiting for their prey to come to them. The males, as soon as they are hatched, look for the females, and if they are fortunate enough to find one hold on to her and from henceforth become parasitic.

As in many other fishes a female angler produces thousands of eggs at a time, which hatch into tiny larvae, of which, as a rule, not more than one or two would grow into mature fish; so that, when they are just hatched, the larval fish are much more numerous than the mature ones of the same kind in that region, and if at this time those of the male sex devote themselves to the search for females there is more chance that some of them may find one than if they waited until later, when their numbers had diminished. If a male finds a mate he must hold on to her by his mouth, it does not seem to matter much where; probably he nips a piece of her skin and so forms a papilla, with which later his lips and tongue unite, so that thereafter he is a mere appendage, as much a part of his wife as a finger is a part of a man. Whatever position he takes up he is sufficiently near to fertilise the eggs when these are shed.

These fishes have thus arrived at a strange solution of the sex problem. The husband's attachment is for life, and if his wife dies he dies with her. On the whole she seems to have the best of it



U.S National Museum & Australian Museum, Sydney

HUNGRY HUNTERS OF THE DARK DEPTHS

All the fishes of the ocean depths are flesh-eating, for there is no plant life at depths beyond two hundred and fifty fathoms, where the influence of light fails. At such depths the pressure of all this water above the fish is tremendous. If caught on a line and hauled too quickly to the surface they arrive distended and with eyes protruding from the sudden alteration in pressure.

MOUNTAIN SHEEP ON THE SKYLINE OF A ROCKY RIDGE IN JASPER NATIONAL PARK, ALBERTA

Animals living among mountains lead a more vigorous life than those of the lowlands, for not only have they their particular enemies to face but also exigencies of weather either unusual or unknown in the plains. Besides this, weather conditions, apart from their severity or otherwise, compared with conditions at lower levels, affect the surroundings of the mountain animals tremendously. The snow that hides all food, and the deadly avalanche, have all to be reckoned with. Mountain animals deal with their physical surroundings with an efficiency that is astounding and seem to know the weather before it has happened. On this faculty their lives often depend. The photograph is reproduced by courtesy of the Canadian National Railways.

Chapter LXXXVI

Have Animals Foreknowledge?

By H. Mortimer Batten

Author of "Habits and Characters of British Wild Animals'

WITHOUT entering upon such problems as migration, there can be no doubt that animals possess many faculties unknown to ourselves, which leaves us with a sense of profound wonderment as to the working of their minds. In dealing with such matters the word instinct is most convenient— instinctive knowledge, instinctive warning, and so on—and however inaccurately it may be applied, we need, nevertheless, to bear in mind that instinct is inherited knowledge, and it may be no more wonderful for an animal to preconceive a pending event than for it to obey more familiar faculties.

Let us seek out one or two examples serving to show how an animal's mind may, under certain circumstances, surpass the human mind. Some of the most remarkable examples have been furnished by that universally detested creature, the house rat. The saying that rats will leave a doomed vessel is, of course, world-wide, but that they will often forsake a doomed building is not so well known. An example of this was afforded during the War period, though at this time it passed without comment and almost unnoticed under the stress of prevailing circumstances. A lady living in an old house in Norfolk was much disturbed during the evening by the commotion among the rats in the walls. The house was filled with their squealing and scuttling, seeming to indicate that they were leaving the building, but eventually silence fell—the rats having apparently evacuated to the last tenant. An hour or so later an airship passed over the building, and dropped a bomb, which demolished part of it.

Those familiar with the world's great ports and dockyards can tell many strange stories concerning the conduct of these highly strung and sensitive animals, and it is common knowledge that when, a number of years ago, a great fire occurred among some warehouses on the Thames Embankment, the rats were seen to leave the building and to swim across the river some time before the fatal spark occurred

NO comment can be made upon such occurrences as these, and there can have been no question of scent or sight or sound having conveyed the warning. Instinctive fear, instinctive dread, the preconception of pending calamity, must have been the moving force, and there are cases on record of human beings, particularly women, having similarly been forewarned. I remember a case of a young officer in the Indian Army cancelling his passage on a certain vessel to gratify an elderly relative, whose dreams had warned her. The vessel actually turned keel on the outward journey, and all on board were lost. But Fate had, nevertheless, placed her finger-tips on the young officer, for his train was wrecked on the up-country trip and he lost his life.

Examples of the human mind rising to these levels are, nevertheless, rare, whereas I believe that it is almost the common order among certain animals. May not the overwhelming and world-wide success of the house rat be partly due to its guarding instincts? We come across only occasional examples, but without paying undue attention to the many tall stories one hears about the cleverness of rats, the fact remains that the more closely one studies them, the more fully does one become convinced that they possess certain powers beyond our understanding. I used at one time to occupy an old house which stood a hundred yards or so from a rapidly flowing stream. During the summer months the rats left the village and took up residence along the banks of the stream which was literally honeycombed with their burrows, and if rain occurred back in the mountains the stream was subject to sudden spate, even though no rain had fallen locally. Thus for weeks of fine weather we would never hear a rat in the walls, then one evening the familiar scuttling would again occur, and someone would remark—" The rats are back. We're going to have a spate!"

This order of things was so regular that after a time it ceased to cause wonder.

I REMEMBER one other illustration. An old mill in Yorkshire had for years been overrun by rats, but one evening they were seen to forsake the building, a great army of them passing through the rushes towards the woods. Needless to say, the old mill had withstood many floods, but the flood which came a few hours later was such that the miller and his family had to flit for their lives. This flood was the result of a local cloudburst which had occurred some forty miles away.

Every trout fisher knows that trout are well aware when a spate is coming, and I have many times been able to prophesy the proximity of fresh water by the mood of the fish. There may have been no sign of rain, but one can never tell what has happened away back in the hills, where a single local storm sweeping a small area, from a certain quarter, may bring down a spate. Repeatedly I have heard something on the lines of the following conversation take place between an angler and a water baillie.

" Any sport, sir?"

" No."

" Nor anyone else. Judging from the fish they are expecting a spate."

Of course, the senses of fish may be very sensitive, for it is certainly a fact that when a spate is on its way they cease to feed absolutely, even though the fresh water is still many miles off; nor will they feed again till it actually reaches them, possibly eight or nine hours later.

WEATHER-WISE CHAMOIS AMONG THE CRAGS OF THE SWISS ALPS

It often happens that the movements of the mountain animals warn those who have the faculty to understand them of the future behaviour of the weather. Here we have a group of chamois in their rocky feeding grounds on the Spietz Fluh, in Canton Fribourg. Living, in these rocky solitudes, is not always easy to pick up, and the older animals have a store of weather wisdom that seems instinctive. At any rate, it is surer than any meteorological instrument yet devised by man.

The sense of hearing of many animals is infinitely keener than our own, and their ability to catch up certain sounds quite inaudible to ourselves may at times mislead us. A farmer once told me that his dog always knew that he was coming home twenty minutes or so before he reached the door. His wife was forewarned by the dog rising from her place by the hearth and going over to the door, where she would utter a single bark for the door to be opened. Investigation revealed the fact that at the end of the occupation road remote from the house and almost a mile from it, was a swing gate, which the farmer was accustomed to bang behind his pony, and I decided that, unquestionably, the dog listened for and heard the gate. Thus I somewhat undermined the farmer's faith in his dog's astuteness, but there was a strange sequel to this. Some years later he came back to me almost triumphantly to tell me that the old dog was now almost blind and as deaf as a post, but that she still knew when he was nearing home !

On the matter of fine hearing we need to bear in mind that there are many sounds we cannot hear, but which animals can hear quite clearly. When at night-time we say that the countryside is absolutely silent, the probability is that it is filled with a host of insect and rodent noises too high-pitched for our ears to detect, but which those of that world hear as distinctly as we hear each other speak. Many people, particularly elderly people, cannot hear the scream of a bat, and the high-pitched scream of the mole is even further from the tuning-fork of human ears, yet such creatures as weasels are guided in their hunting by these sounds. The case of a stoat hearing the sounds of rats in a byre half a mile away came before my notice, and having regard for such exquisite senses, many mysteries vanish in connection with the conduct of animals.

But just as the smallest of them can hear these high-pitched sounds inaudible to ourselves, I believe they are totally unable to hear many deep sounds which we hear distinctly. I have fired shot after shot at a stoat, yet such was his conduct that one was almost justified in believing that he was quite unable to hear the deep report of the gun

A GREAT deal concerning the strange movements of animals can be set down to the weather sense, which man does not seem able to acquire to the same extent as those animals whose movements are

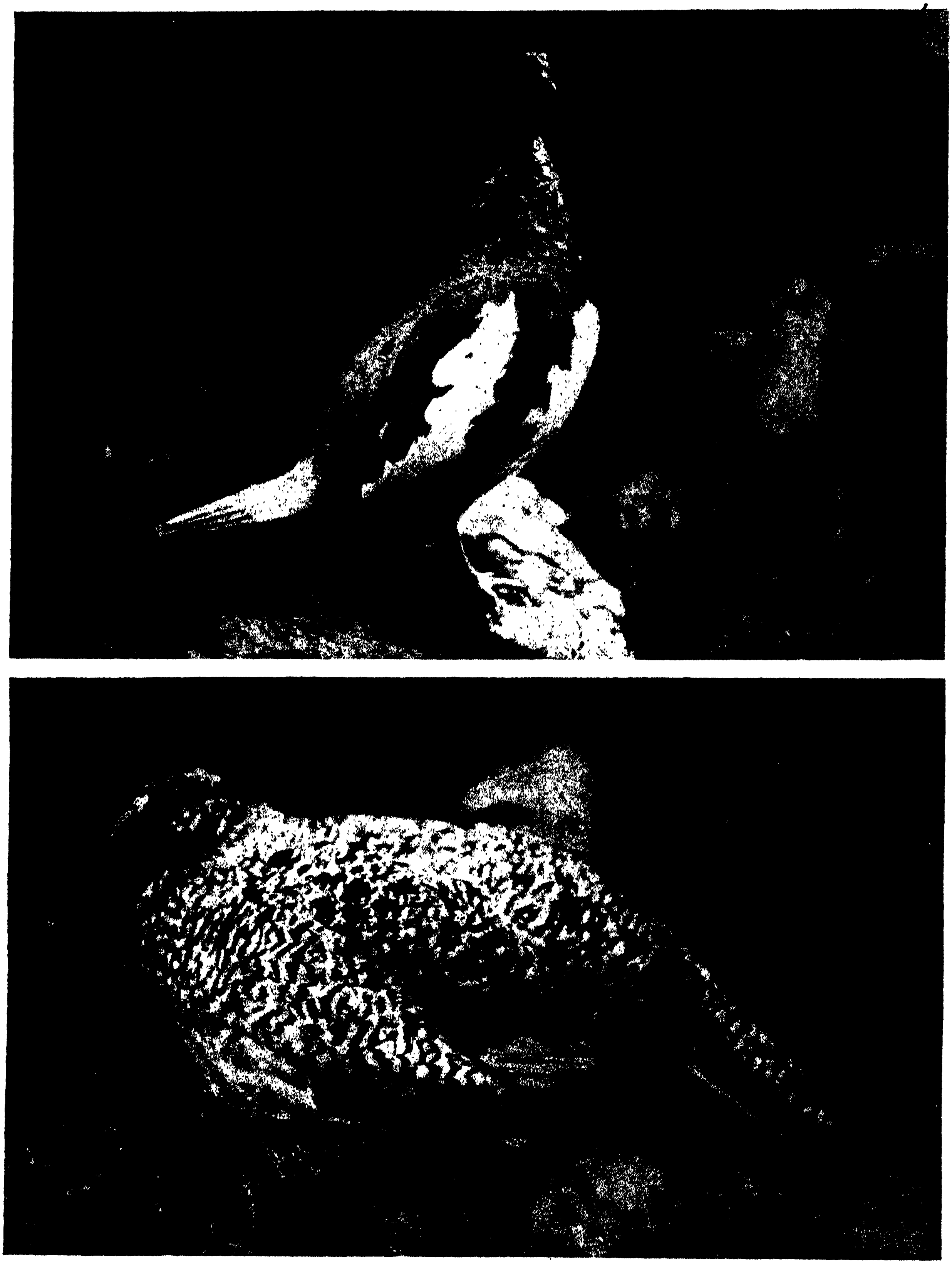
governed by the weather. The Red Indian may be taken as the master of woodcraft, and though the best Indian is often a wonderful weather prophet, it will be found that his judgment is based solely on the movements of birds and animals. They are his barometer; he himself never becomes so weatherwise as the creatures of the wild.

Naturally, animals of Alpine habits are governed by the weather to a far greater extent than those of the low country, and every year one may witness the most astounding examples of foresight as to what the future holds from such creatures as deer, ptarmigan and mountain hares. Repeatedly I have watched the deer pouring down from the high ridges, albeit there was no indication of storms, the barometer standing high, and the sky clear. Perhaps two hours, perhaps twenty hours later the cause of the general movement has become evident. Similarly, in spring

S. C. Johnson

CREATURES WITH PREKNOWLEDGE: BROWN TROUT AND RATS

Of the many reasons—or excuses—given by anglers for not catching fish to-day (whereas yesterday they had done wonders) is the mysterious reason of the spate. Trout may be on the feed and rising gaily, when suddenly all signs of them cease. An hour, or six hours, perhaps, later the river suddenly rises and is in spate. How the fish knew of the spate is a mystery. Above is the familiar rat, apparently endowed with preknowledge of disaster to the place where it dwells.



W. S. Berridge

PTARMIGAN THAT ARE WISE BEFORE THE EVENT IN BAD WEATHER

Ptarmigan, a species of grouse, seem to have an uncanny knowledge of the future, not only as regards approaching weather but of conditions generally, for they will suddenly, for no evident reason, entirely forsake a locality where they were once plentiful and go elsewhere for four or five seasons It will be often found afterwards that those seasons were all unfavourable, and the birds do not return until some instinct tells of a renewal of better conditions Below is a hen ptarmigan and, above, a cock bird

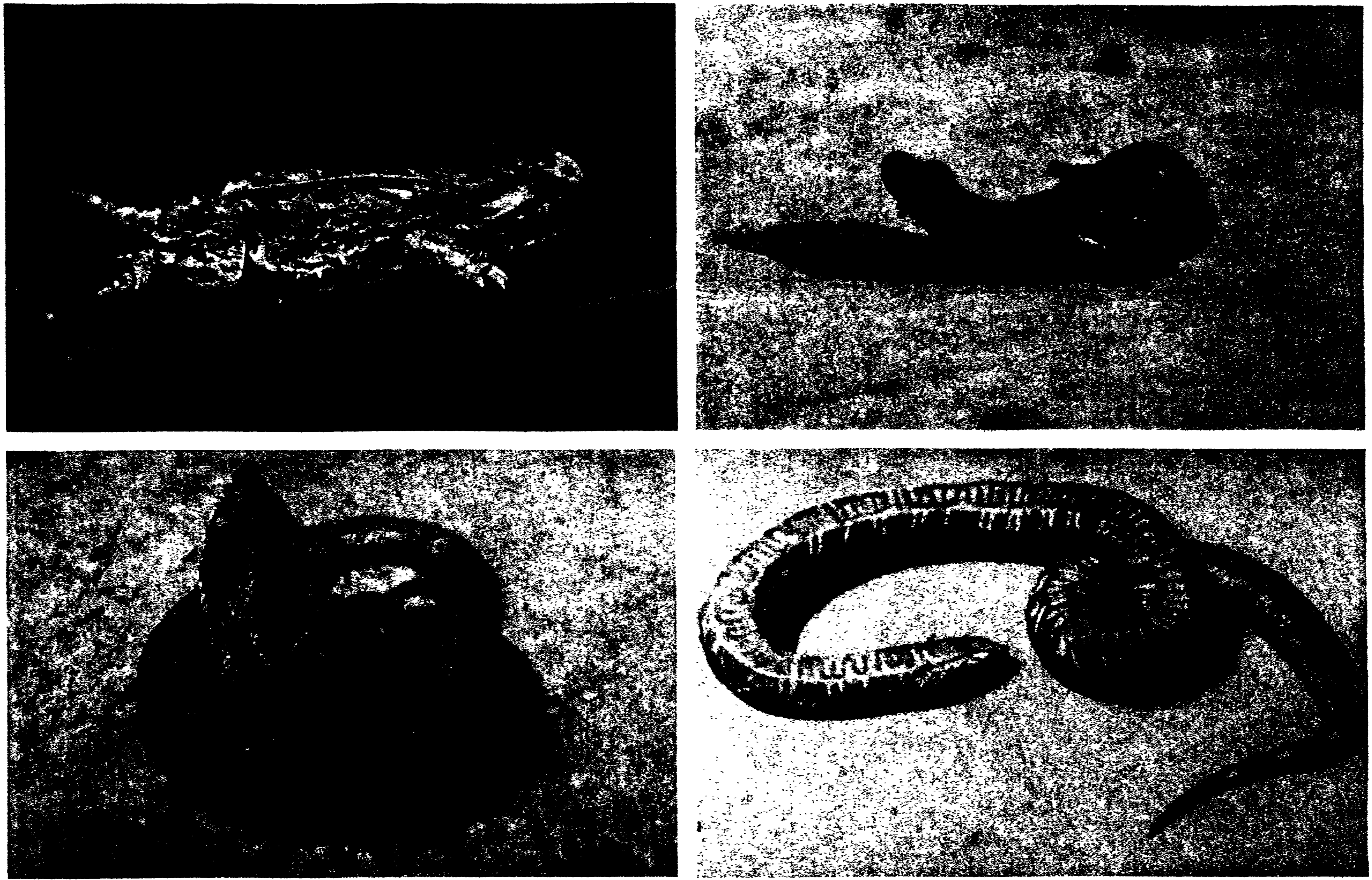
W. S Berridge

MOUNTAIN HARE AND PTARMIGAN IN WINTER

When winter comes the mountain hare and the ptarmigan both change their coats. The ptarmigan is the only British bird which changes its plumage for protective purposes in winter. The mountain hare also has an apparent pre-knowledge of weather conditions leaving a district for several years together, in advance of inclement conditions

I have seen the hinds taking their calves out of the sheltered glens towards the sunning slopes when the weather conditions were so miserable that one might have thought that the sun would never shine again, but next day, or a few hours later, the calves were revelling in their sun baths under the peat hags.

Mountain hares are still more mysterious in their movements. Often with them it is not merely a matter of local migration, but of migration on a wholesale scale. The hares at a certain time leave the entire slope of the range, forsaking it utterly for four or five years during a period of unfavourable winters, resulting perhaps in unfavourable food conditions. The movements of the ptarmigan are identical, and I cite these cases not because they have any bearing on the subject under discussion, but because they go to show how the power of seeing into the future governs the whole system of life where life is dependent upon the weather. My object has been to quote a few simple cases which I know to be proven, illustrating the wonder of animal foresight, and therefrom to lay before the reader some facts which may lead to a better judgement of such things It would not be difficult to dwell at length upon available examples proving that birds and animals *can* see into the future, and that, could we read their movements rightly, we should find in them a barometer far more sure than any human instrument But the reading of that barometer would demand years of intimacy with Nature's secret



W. S. Berridge

CLEVER TRICKS PERFORMED BY THE WEAKER MEMBERS OF THE ANIMAL WORLD FOR SELF-PROTECTION

Among the most clever of Nature's "artful dodgers" is the hog-nosed snake of America. It is perfectly harmless but, when in danger, it imitates the action of the cobra. Raising the forepart of its body, it puffs out the skin of its neck into a resemblance of the cobra's hood (bottom left). But if this ruse is not successful the cunning thing writhes as though in the throes of its last moments and turns over on its back as though quite lifeless (bottom right). The horned lizard (top left) has the amazing habit, when alarmed, of swelling out its body until there is a rush of blood to its head and blood squirts from the corners of its eyes to a distance of five feet. The yellow-bellied toad (top right) feigns death when frightened.

Chapter LXXXVII

The Clever Tricks of Feeble Folk

By W. S. Berridge

Author of "Marvels of Natural History"

The life of the wild creatures that populate the earth may truly be said to be a continual struggle for existence, for every individual is faced with the problem of outwitting, evading, or overpowering its enemies. Nature has ordained that the carnivorous beasts shall live at the expense of other creatures, and even those that do not fall under this category are themselves potential victims of their more bloodthirsty kindred.

Many animals rely upon their strength to overcome the dangers that beset their path; others win safety by their extreme vigilance; while not a few resort to subterfuge, and may be said to live by their wits.

One of the most remarkable habits indulged in by certain mammals, birds, reptiles, and amphibians is that of " feigning death." This expression, however, implies a knowledge of death, and many people will assert that no animal is able to visualise that state, or can be aware that life is not without end. It has been stated that the phenomenon is due to a kind of paralysis caused by fright; while another suggestion put forward as an explanation is that the animals that act in this manner are thrown into a cataleptic state under the influence of hypnotic power.

Although it is not unreasonable to suppose that a snake or toad is not endowed with sufficient mental development to be able to realize the meaning of death, can the same be said in regard to the higher types of animals? We know, for instance, that a domestic cat will leave its home and go to some quite unwonted place to die, an act that surely points to some kind of knowledge on the animal's part of its approaching end.

But whether the creatures that feign death have, or have not, any idea of what their actions portray, there can be no disputing the fact that their behaviour is of a definitely defensive nature.

J. J. Ward

INGENIOUS PRETENCE

The Australian case moth has invented a most ingenious piece of trickery. The larva develops in a little case made of bark and leaf fragments, and this case serves also for a cocoon in the pupa stage. The creature thus runs little risk of discovery.

One of the greatest adepts at the art of deception is the hog-nosed snake, a harmless species, found in America, that grows to a length of about three and a half feet. When alarmed, this reptilian humbug assumes the pose of a cobra about to strike, raising its head into the air, and expanding the skin-folds of its neck. A person unacquainted with the snake might well imagine he was confronted by a venomous species, and would doubtless move off as soon as possible; but should he be aware it is harmless, and not be taken in by its attitude of defiance, the artful snake tries another ruse. Writhing upon the ground as if it were in the last throes of death, the reptile eventually turns over on its back and remains motionless, even allowing itself to be picked up without showing the least signs of life. But no sooner has the disturber of its peace departed than it quickly comes to life again, and makes off to shelter, gratified, no doubt, at the success which has attended its little game of bluff.

An amusing story is related by Mr. R. E. Ditmars in regard to one of these snakes. Travelling through a forest, accompanied by a number of native porters, he came across one of these reptiles, and, noticing the men were afraid of the creature, he thought he would make an impression upon them by showing off his powers as a snake-charmer. Approaching the reptile, he made a few magic passes over its body, with the result that it turned over on to its back and shammed death. Mr. Ditmars then picked it up, and, having shown it to his followers, invited them to watch him bring it to life again; a feat he accomplished by the simple expedient of replacing the reptile upon the ground, and remaining motionless and quiet a short distance away. But this display made rather too good an impression upon his audience, for they considered his powers to be bordering upon the supernatural, whereupon they disappeared one by one, and left him to continue his journey alone and in a very awkward predicament.

F. Vear

BLACK-HEADED GULL IN THE ACT OF TURNING ITS EGGS

Towards the middle of April the black-headed gull lays her eggs, usually three in number. These are about two inches long and vary considerably in colour between blue, olive or brown-green with brown and black markings. In this splendid photograph the bird is seen turning her eggs, a process which birds go through periodically during incubation in order that each egg may be properly aerated and receive the life-giving warmth on every side. This gull is found half way round the world from England to Japan.

Although many of us may not have had the opportunity of witnessing the artful behaviour of the hog-nosed snake, in Europe there are some very common toads, known as the fire-bellied toad and the yellow-bellied toad, that sham death at the least provocation When disturbed, they turn over on to their backs and lie motionless with their bodies contorted into the weirdest postures.

Although the attitude assumed renders the bluffers very untoad-like in appearance, and may well deceive other creatures into imagining them to be merely inanimate objects, the chief reason why they behave in such a manner is to display the red and yellow warning colours on the under parts of their bodies ; for as the toads are of a very unpalatable nature, the bright tints at once proclaim to those that have had previous experience of supping upon them that they are better left untouched

Another animal that has earned a reputation as a trickster is the Virginian opossum, and the expression ‘ to play ’possum ” is proverbial. When captured, it immediately pretends to be dead, lying motionless upon the ground with its tongue hanging out of its mouth, and even allowing itself to be beaten.

But even greater endurance is exhibited by the South American fox-like animal known as Azara's dog, and also by the Australian dingo dog. The latter, when shamming death, has been known to allow a portion of its skin to be removed without flinching, and equally horrible stories have been related about the former beast.

One would hardly expect such an innocent-looking animal as a deer to indulge in subterfuge, but one of the mouse-deer or chevrotains, called the kanchil, will assume a deathlike pose when captured, a habit so pronounced that the natives will speak of a deceitful person as being " as cunning as a kanchil."

Most of the bees of the Andrena group, of which there are as many as sixty representatives found in the British Isles, will also feign death as a means of self-protection, and should a person pick one up it then emits a peculiar odour that some people regard as pleasant, and others as just the reverse.

Spiders, moreover, when dislodged from their webs, will often fall to the ground and lie motionless with their legs held tightly folded against their bodies, and in this attitude they look more like small stones than living creatures. At other times they will let themselves down suddenly, suspended by a thread, and then make off to safety; a trick also practised by certain caterpillars.

Even among lizards there is one species that will feign death when alarmed. Unlike the majority of its kind it possesses such short legs that it is incapable of eluding its enemies by running away; but by shutting its eyes and holding out its legs stiffly on either side of its body, it makes itself look as if it were dead—an artifice that is not infrequently successful and saves its life.

Another means by which some lizards will evade capture is by discarding the tail, or a portion of that member. But this act of self-mutilation is not of such a drastic nature as it appears to be, for many of the bones of the tail are divided across the middle and merely held together by a thin pad of gristle, the severance always taking place at one of these joints, without loss of blood. A discarded tail is eventually renewed, sometimes as a double structure, for the operation of this replacement is apt to be a little eccentric, but the bones of the new growth are only replaced by a rod of hardened tissue.

Arthur Brook

CAUTIOUS PEEWIT APPROACHES ITS NEST

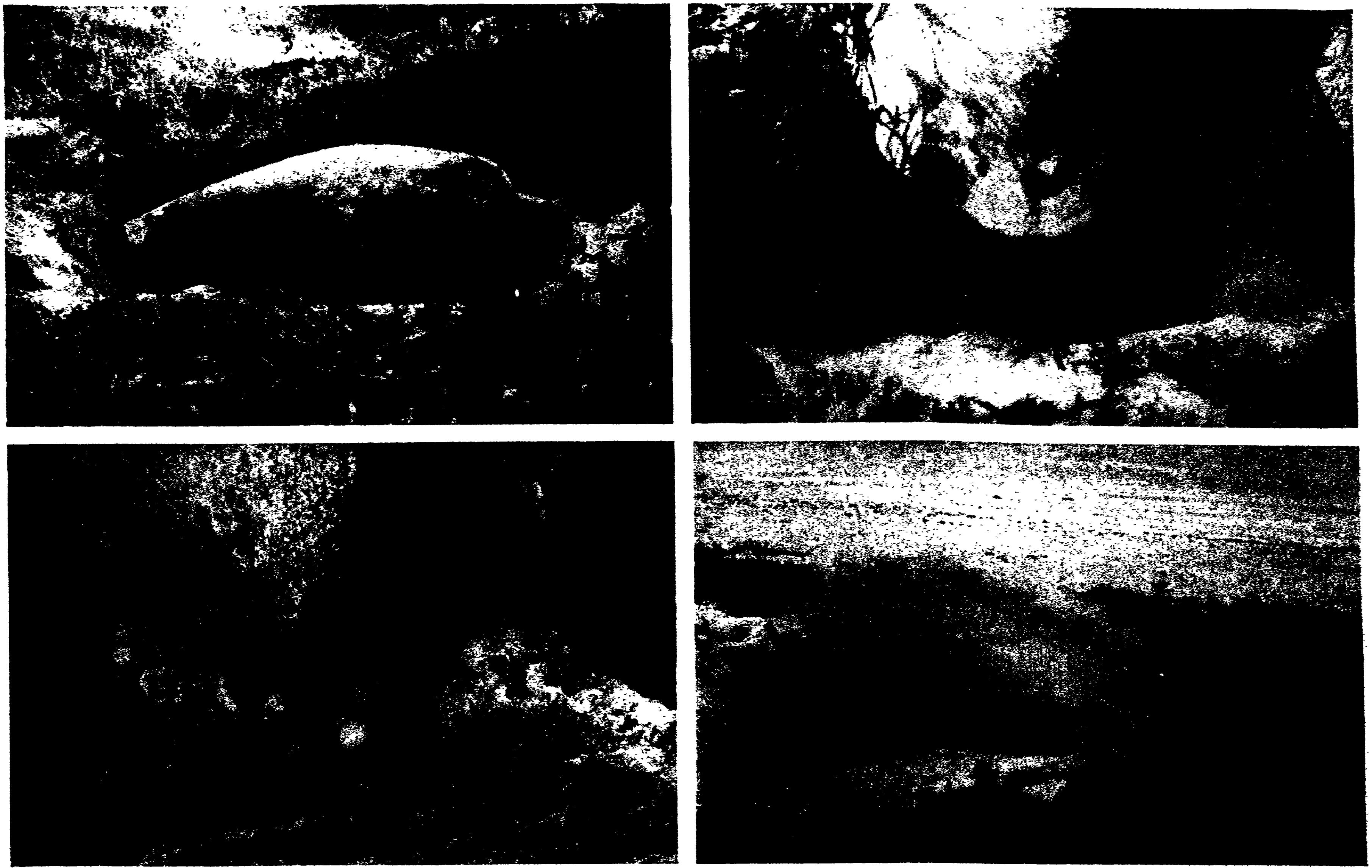
The peewit never flies directly to its nest but alights some way off and then runs through the grass to the eggs. If man or beast approaches the cunning parent hops a little in front of the trespasser and pretends to have a broken wing, thus hoping to lure the enemy into pursuit. The bird draws her dupe well away from the nest and then flies off.

STARFISH and crabs will also surrender a limb when in difficulties, this act being accomplished by violently contracting the muscles at the base of the member about to be discarded; while spiders will jerk off their legs, and the long ribbon-worms that lurk beneath stones on the seashore will break into numerous pieces

A most remarkable method of defence is that adopted by the horned lizard, or horned toad, as it is sometimes called. When cornered or captured, it opens wide its mouth, swells out its body, and then spurts out jets of blood from the corners of its eyes to a distance of as much as five feet. This astonishing behaviour is due to excitement, and causes a rush of blood to the head, the eyelids then swelling out to such an extent that they may be as much as three times their normal size.

The ejection of a fluid as a means of defence, however, is not restricted to the horned toad, for we have in the llama and its kindred, the skunks, and the artillery or bombardier beetle other examples of creatures that act in this manner.

Those of us who have visited zoological gardens have probably at some time or other been brought face to face with the spitting habits of the llama, and as the animal aims with a precision that a



Otho Webb

GREAT PRECAUTIONS TAKEN BY A FEMALE GREEN TURTLE IN THE LAYING OF HER EGGS

When the time of the year arrives for the female green turtle to lay her eggs, she swims ashore and selects a suitable nesting site on the sand. This done, she scoops out a hole with her flippers (top left) for her body to rest in. She then deepens the hole, using her flippers alternately to dig and prevent the sand falling back into the excavation again (top right). She then lays the eggs (bottom left), from one to two hundred of them, in the hole which is about ten inches wide and eight inches deep. Finally she heaves herself out and throws back showers of sand until the site of her egg-laying is quite concealed, as we see in the bottom right-hand photograph, where a stick has been placed in the sand to mark the right spot.

human marksman might envy, its behaviour can be very unpleasant to the victim, though doubtless a source of amusement to the beholders.

But to be assailed by the evil-smelling fluid ejected by the skunk is a more serious matter, for one drop upon the clothes of a person would make his presence unbearable to others, and there would be no alternative but to destroy the garment thus contaminated. The fumes arising from the liquid are so strong that were a man to inhale them without a large admixture of air he would not only become unconscious in a very short time, but his temperature would fall, and his pulse would weaken.

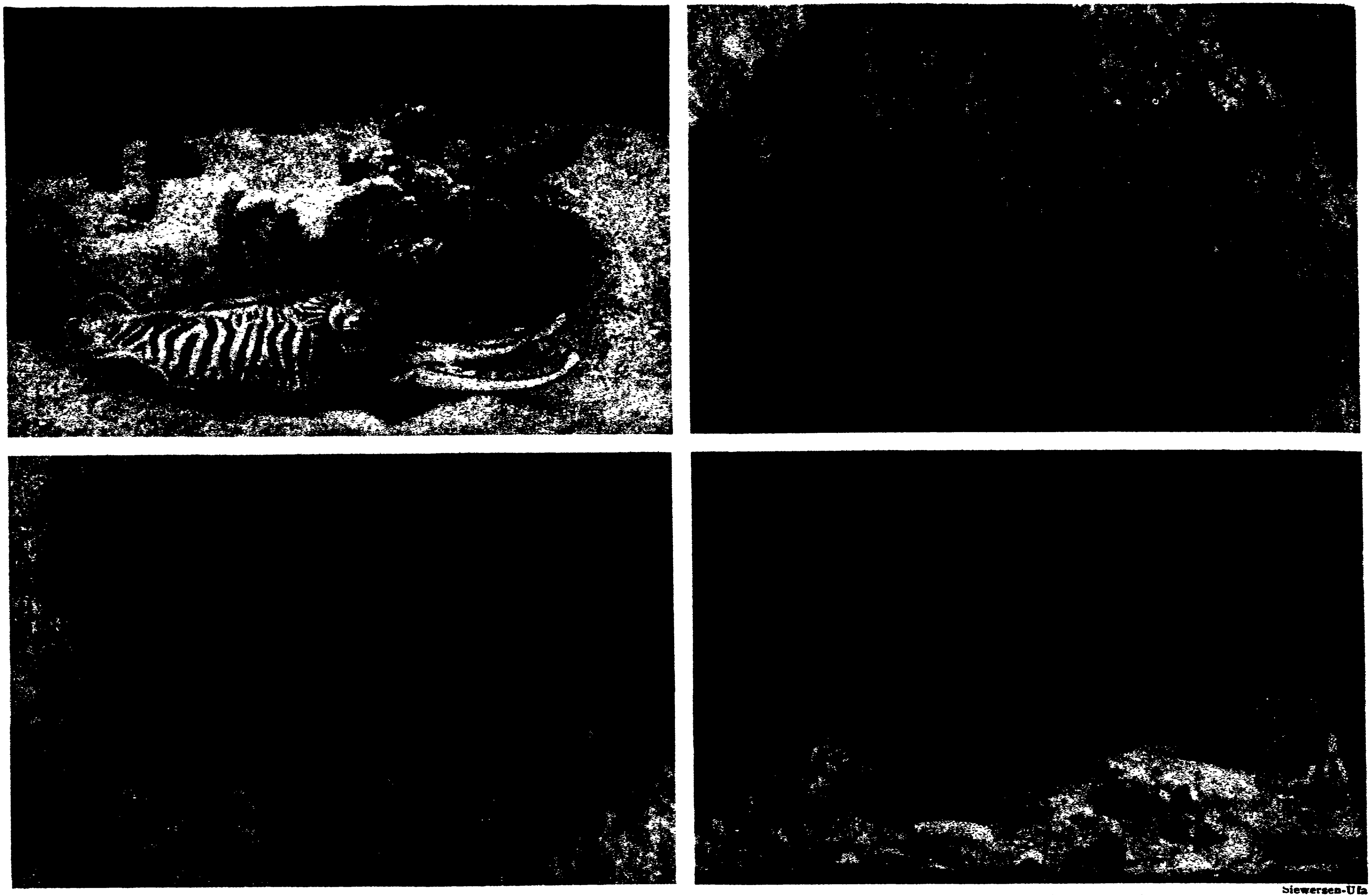
It is not only mankind that gives the skunk a wide berth, for experience soon teaches all living creatures to refrain from molesting it. Nevertheless, if the glands secreting the fluid be removed, the animals make quite nice pets, and their presence in zoological collections is not then fraught with the danger of unpleasant consequences

The conspicuous black and white fur of the creatures is much sought after for making up into ladies' cloaks and other garments, and in North America many skunk farms have been established where the animals are reared in captivity Moreover, farms devoted to this purpose have been started in England, one being situated near the Kestor Rock, Devonshire, and another on the high and bleak part of Dartmoor

Some beetles secrete an acrid fluid which they eject as a means of defence, and in one group the liquid volatilizes when discharged, and comes forth like a little cloud of smoke The most familiar of this class is the bombardier or artillery

GREEN TURTLE CONCEALING HER EGGS

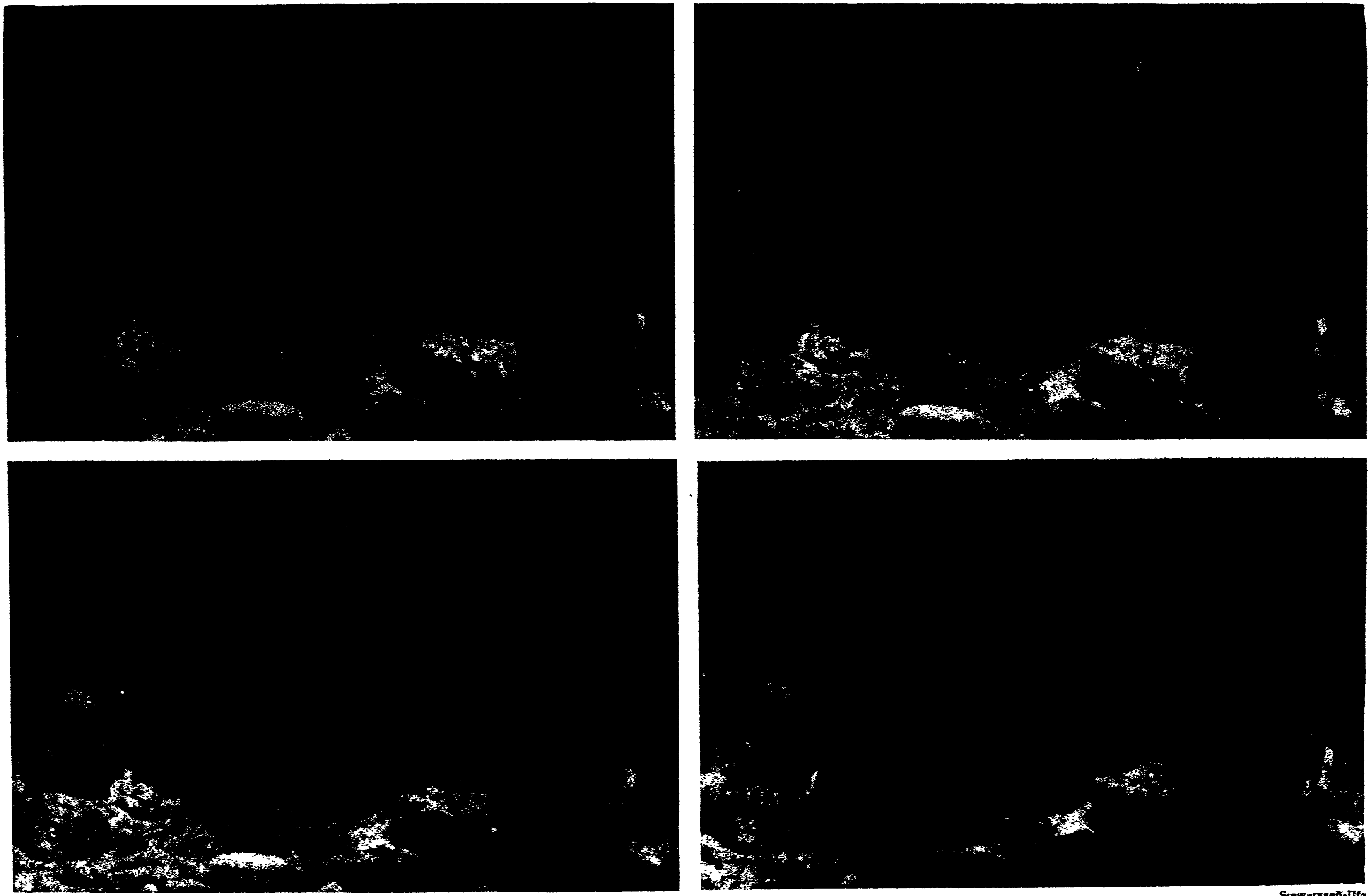
Below we see the egg chamber which a green turtle dug and where she deposited her eggs, excavated to show the hatching eggs inside. Above the turtle is packing the sand firmly down over the site after having piled it up as we saw in the preceding page This prolonged egg burying is a remarkable instance of animal cleverness



Siewersen-Ufa

CRAFTY CUTTLEFISH WITH MANY ENEMIES BUT WITH THE MEANS TO ESCAPE THEM ALL

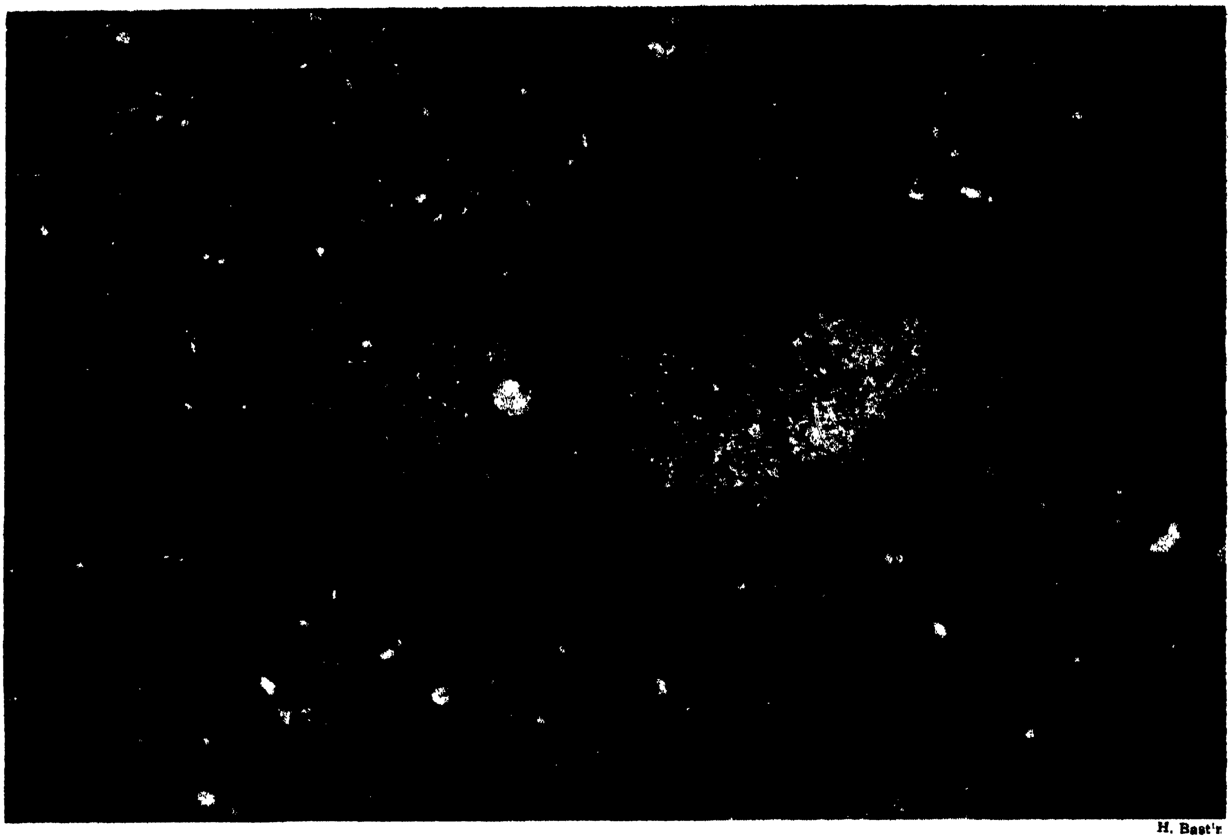
For emergencies the cuttlefish keeps two protective tricks, the first a quick change, and the second a disappearing trick. The first is performed by the fish's ability to change colour to match its surroundings. This is effected by the contraction or expansion of a number of minute cells containing pigment and called chromatophores. The bottom left and top right photographs show magnified portions of the fish's skin with these colour cells in different stages of expansion. One of the cuttlefish's disguises is the zebra pattern (top left). Notice the tentacles, ten in number, the two longest being used for catching food. The bottom right-hand photograph shows the first stage in the use of the second line of defence (see also page 955).



Siewerssen-Ufa

QUICKLY-ENVELOPING CLOUDS OF SEPIA DISCHARGED BY THE ESCAPING CUTTLEFISH

If the cuttlefish decides that mere imitation of its background has failed to deceive an enemy it empties the contents of a remarkable ink-bag into the surrounding water. We have, above, four stages of the development of one of these discharges which much resemble, both in appearance and in use, the smoke screens sent up by warships. Under cover of these inky clouds of opaque liquid the cuttlefish easily escapes. The liquid is collected commercially to supply the pigment called sepia. It colours the water for many yards around the site of the discharge and only dissolves slowly, and by the time this has happened the fish is far away.



H. Bastin

W. Saville Kent

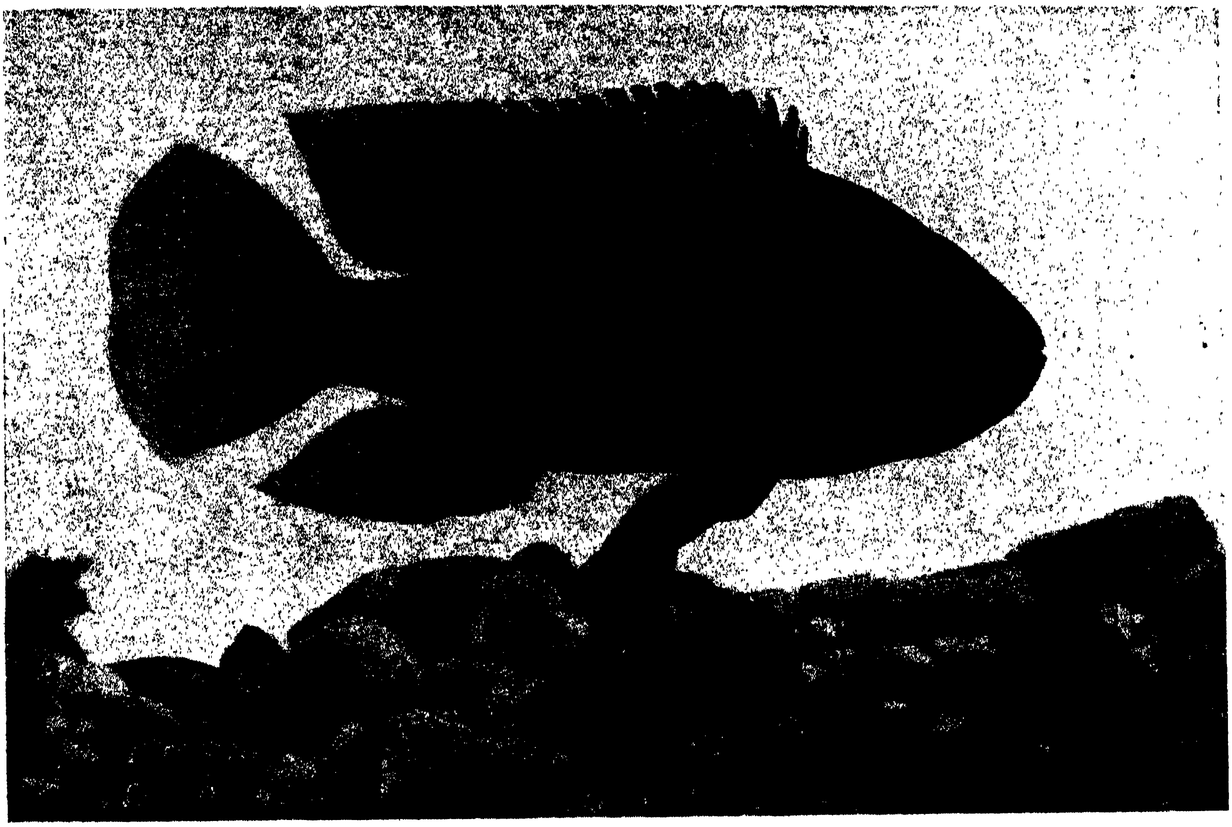
HOW OYSTERS AND SOLES PROTECT THEMSELVES

Oysters make pearls for a very utilitarian reason. Should any foreign body—dead or alive—get by mishap within the oyster's valves the intrusive object is slowly covered over with a secretion which becomes a pearl. Here is one with a little fish inside. Above is a sole with its outline obliterated by the sand collected on the edges of its body when the fish settled down.

beetle, a creature very fond of hiding under stones, and one found in considerable numbers in the counties of Southern England.

Should a person pick up a bombardier beetle, it will immediately fire off its artillery, the discharge sometimes being accompanied by a slight noise. But some of the larger species found in foreign climes are able to produce quite an appreciable amount of sound, one kind found in South America having been known to crepitate two or three times in succession. Its emission is accompanied by a sensation of burning in the fingers that hold it, and a brown stain is left upon the spot that comes into contact with the vapour.

Somewhat similar behaviour is indulged in by the larva of the puss moth, which is provided with a squirting apparatus situated in the cleft of the neck. When the caterpillar is irritated it protrudes a curious organ, divided into four branches, and perforated by holes like the rose of a watering-can. The entomologist De Geer gives an interesting account of the behaviour of one of these caterpillars he found resting upon a twig. "As I was scrutinizing its appearance," he writes, "I happened accidentally to touch its body. Instantly there shot out, from a



spot near the neck, two streams of clear fluid, which struck me on the face, and partly entered one of my eyes, causing a very acute, but fortunately, not a very enduring pain."

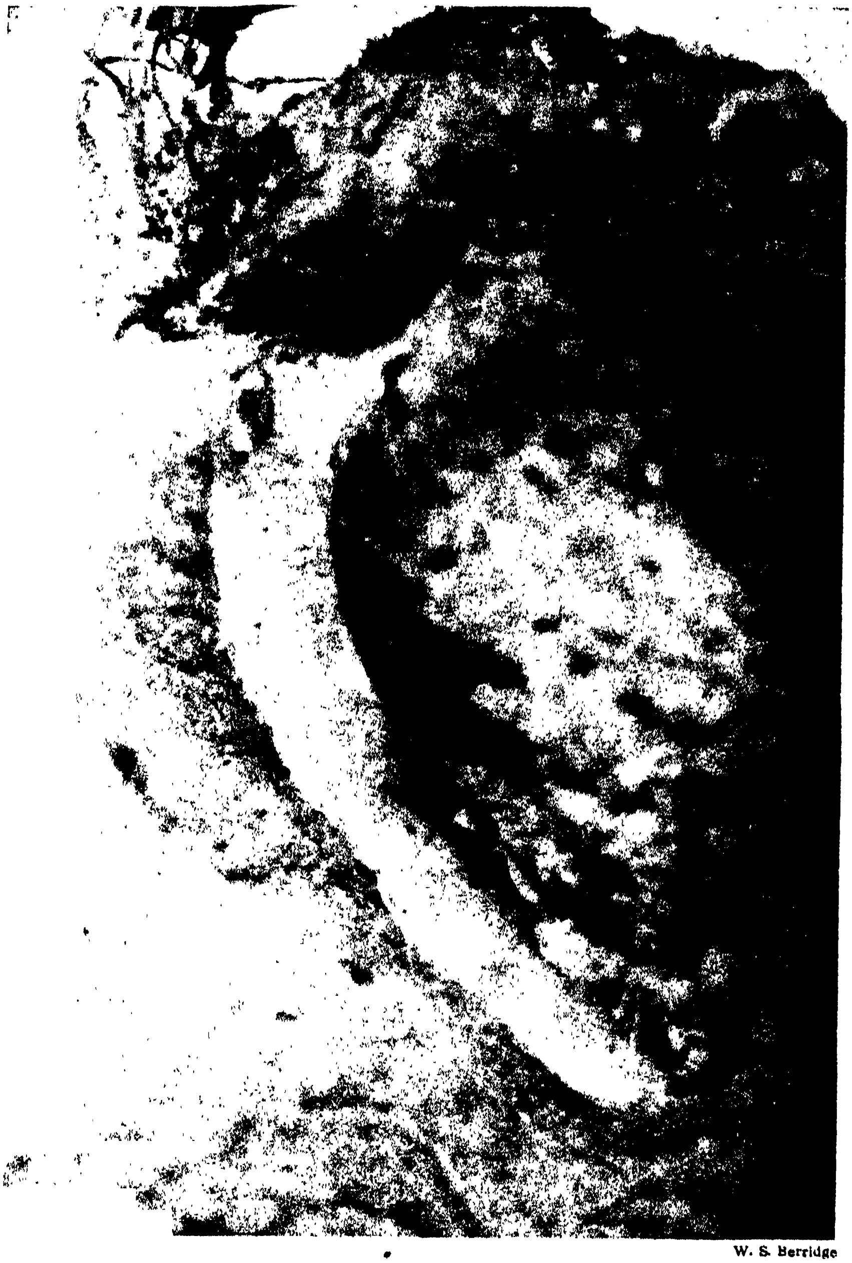
But the puss moth larva has another curious arrangement on the hinder part of its body. The last pair of legs, or "claspers," have vanished, and are replaced by a pair of tubular organs containing two long, slender, and whiplike growths that can be protruded or retracted at will. Although the exact utility of these is unknown, it is generally assumed they are of a defensive nature. A writer in an old book, however, tells us that the caterpillar "possesses the power of lashing its sides with its tail, so as to drive away flies" but we need hardly state that the story is untrue.

Protective ejections are also emitted by certain kinds of millipedes which exude an evil-smelling and oily secretion from the pores of their bodies; while a species of locust found in Algeria will eject a noxious fluid for a distance of nearly two feet. Someof the "soldier" termites repel the attacks of hostile ants by squirting out a gelatinous liquid secreted by glands leading to a small opening at the end of their projecting

W. S. Pitt

GOLDEN CICHLID THAT BELIEVES IN SAFETY FIRST

The cichlid's eggs are laid on a rock and the parents keep the water moving over them by fanning with their fins for several days until hatching takes place. The little ones —perhaps four hundred of them—are then put into depressions in the sand, being moved about constantly until they are old enough to swim.



W. S. Berridge

SECTION OF A TRAP-DOOR SPIDER'S LAIR

This photograph shows a piece of earth, magnified, which contains the burrow of a tropical trap-door spider. The piece has been cut in half so as to show the whole burrow with the trap door at the top. This door moves on a hinge, and the spider lurks inside until something to eat comes within reach. Out darts the spider, drags its prey into the burrow, and the lid shuts.

beaks; while the oil beetles and ladybirds are other examples of insects that resort to this ruse when alarmed.

Among the birds there are quite a number that practise subterfuge, the feathered humbugs endeavouring to lure their foes from the vicinity of their nests by pretending to be wounded in the wing. The lapwing, the landrail, or corncrake, the water rail, the hoopoe, and the American spotted tinamou will all act in this manner, and it is somewhat astonishing to note that the ostrich has been known to play a similar game of bluff

Canon Atkinson gives an amusing account of the deception played upon him by a landrail that had been caught by his dog. The bird lay upon the ground upon its side as if it were dead, even allowing itself to be turned over without showing signs of life. The narrator then placed it in his pocket, but no sooner was it inside than it came to life again, and endeavoured to get out. The trickster was then replaced on the ground, and immediately it continued its efforts to deceive; but after remaining motionless for some time, it suddenly raised its head and flew quickly off.

But let us now consider the sea creatures and see what stratagems they adopt to evade their enemies.

Some of them seek companionship with jellyfish, sheltering beneath the stinging tentacles of their hosts; the young of the horse mackerel, or scad, and the fry of the whiting following this practice.

A species of fish inhabiting Australian seas selects as its partner the large jellyfish known as the Portuguese man-o'-war, an individual sometimes sheltering as many as ten finny guests at a time beneath its long, trailing arms, while a certain kind of herring will be found associating with a jellyfish found off the American coasts.

Other marine animals with curious defensive habits are to be noted in the spider crab, the octopus, the sepia, or cuttlefish, and the squid. The former, which receives its name from the triangular shape of its body, and the great slenderness and length of its legs, endeavours to keep out of sight of its enemies by making itself as inconspicuous as possible. It will attach pieces of seaweed or other marine growths to its carapace so as to make itself look like its surroundings. That the crab evidently realizes the benefit of its protective attire has been proved by an interesting experiment. Seaweed-covered individuals have been captured and placed in a tank bedded with small sponges, whereupon the shellfish discarded their original raiment, and, picking up some of the living sponges with their claws, attached these to the hooked hairs upon their shells as more effective disguises.

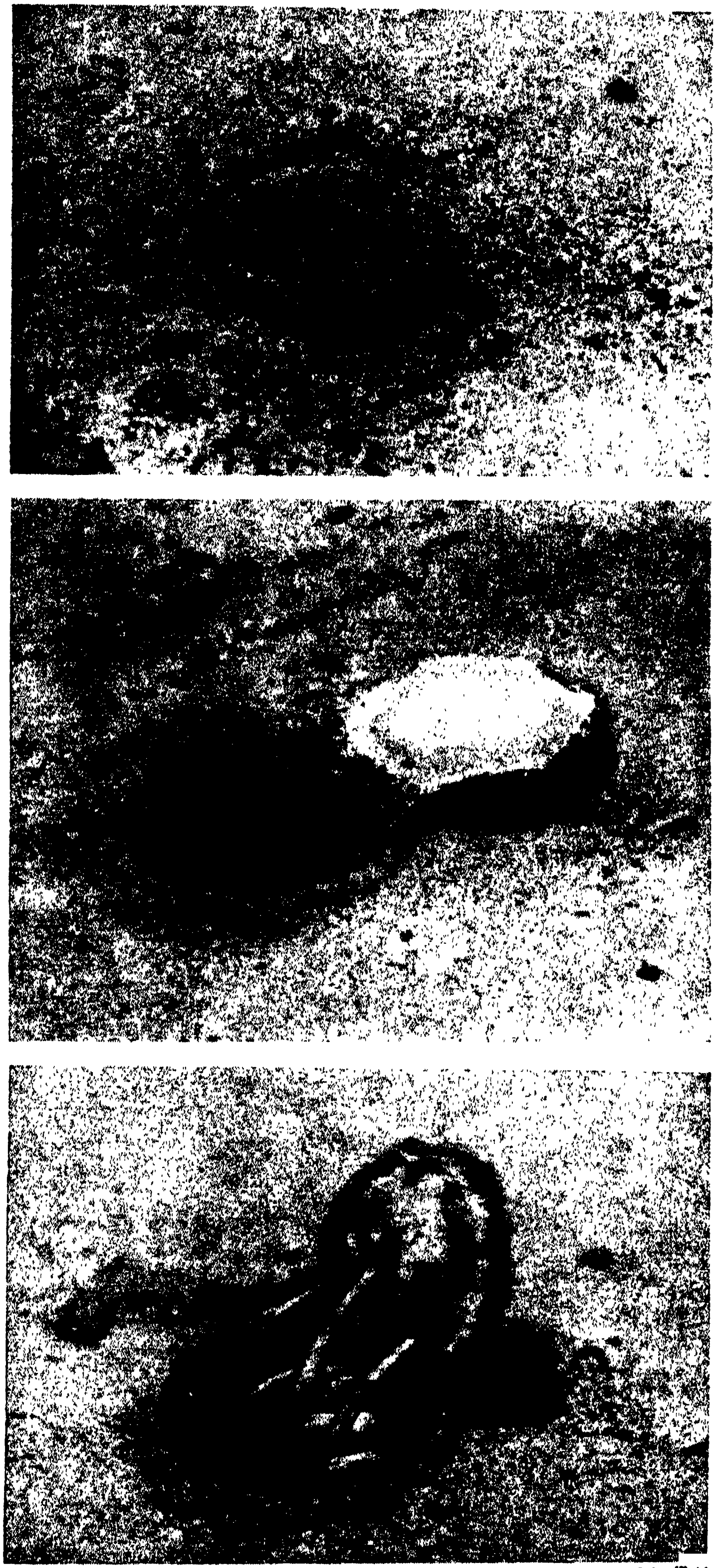
The octopus, cuttlefish, and squid are all provided with "ink bags" from which they are able to eject a dark-coloured fluid. This forms a "smoke screen," and discolours the surrounding water to such an extent that the creatures are able by this means to escape from their enemies. The "ink" of the cuttlefish is employed in the making of the sepia pigment used by artists; while the curious oval, broad, and flattened internal shell supporting the animal's body is known commercially as cuttle bone, and is often sold for hanging up in the cages of small birds. The internal shell of the squid, however, is very slender, one end terminating in an oval-shaped and flattened expansion vaned like a feather. This structure is commonly spoken of as the "pen," and as the squids are in the habit of emitting a dark coloured fluid as a means of evading their enemies, they have been given the name of "pen and ink fish."

A form of defence we have not yet mentioned is that of rolling up, an artifice indulged in by certain creatures that are only protected upon the upper part of their bodies, the under parts being soft and very vulnerable to attack.

A well-known example of such an animal is the three-banded armadillo, or mataco. "It has the power of rolling itself into a perfect sphere like one kind of English woodlouse," writes Darwin. "In this state it is safe from the attack of dogs; for the dog, not being able to take the whole in its mouth, tries to bite one side, and the ball slips away."

Other creatures that curl up when alarmed are the scaly pangolins of south-eastern Asia and South Africa. They roll up into a tight ball, the snout being thrust between the forelegs, and the tail pressed tightly against the body, between the hind legs. The bending of the body causes the sharp edges of the scales with which they are provided to stand on end, and for an enemy to attempt to bite such formidably armed creatures would most certainly be to court disaster

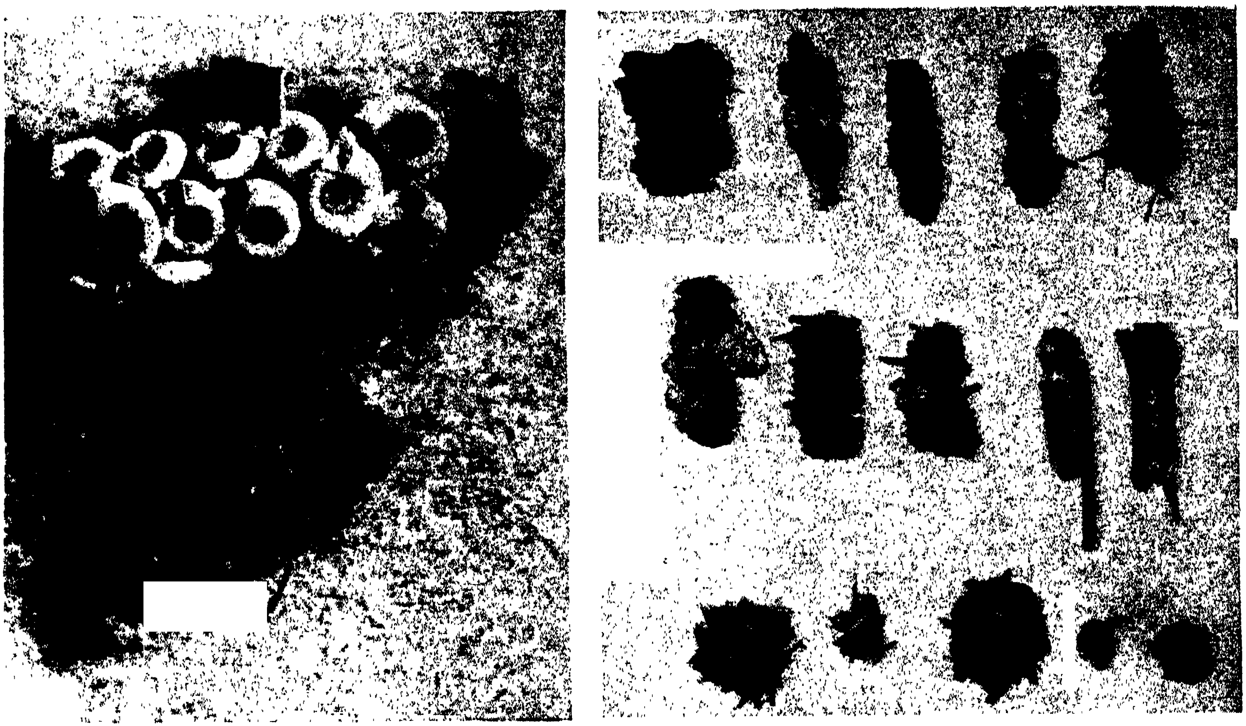
But an even more familiar instance of this habit is presented by the hedgehog It possesses numerous cutaneous muscles, one of which forms a broad band around the body When contracted this draws together towards the centre of the under part of the body the lower edges of the spine-covered skin, and as the head and legs are simultaneously tucked under the belly, the creature then assumes the shape



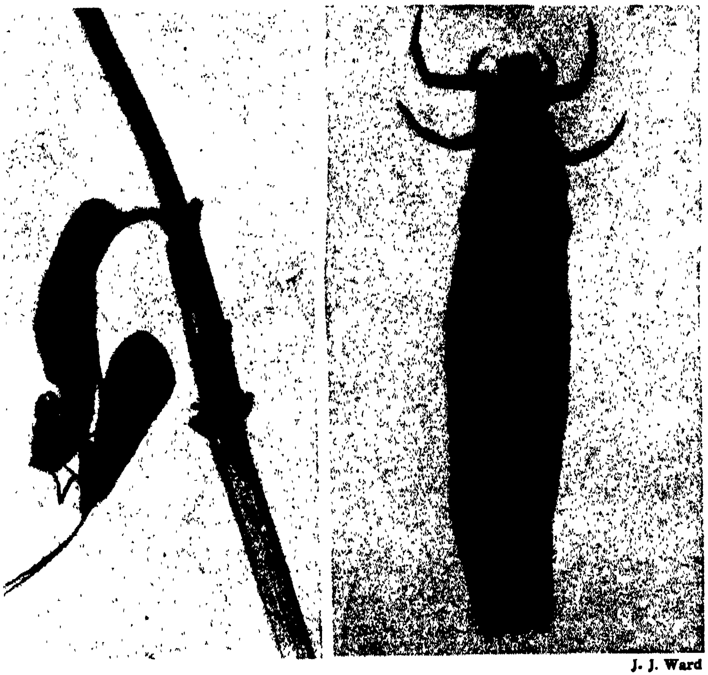
Otho Webb

OPERATION OF THE SPIDER'S "TRAP DOOR"

The trap-door spiders are found only in warm climates. The trap door of the "oubliette" they build is made to harmonise with the surrounding soil. These photographs, natural size, show (top) the door just open, (centre) with the silk inner side visible, and (bottom) the owner emerging



M. H. Crawford



J. J. Ward

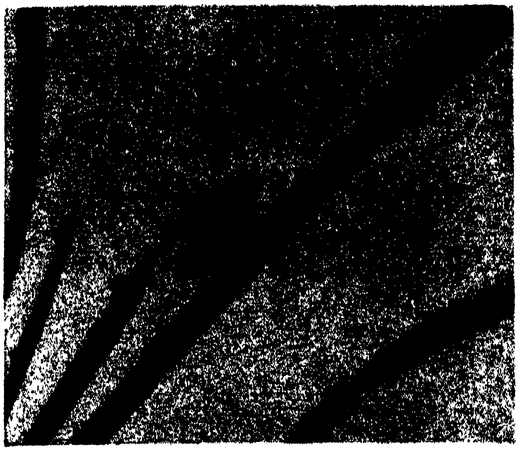
CADDIS FLY CAMOUFLAGE

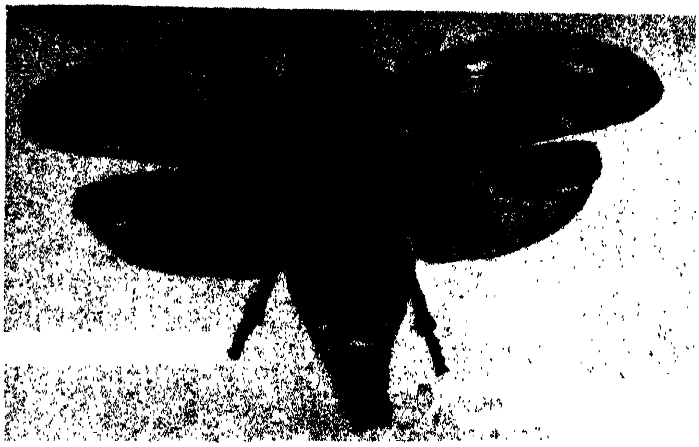
These photographs show the perfect caddis fly (bottom left) and its queer-looking larva when it has been removed from its wonderful case (bottom right); two cases (top left) very much magnified, one disguised with water snails and the other with gravel, and (top right) some miscellaneous examples of this clever camouflage.

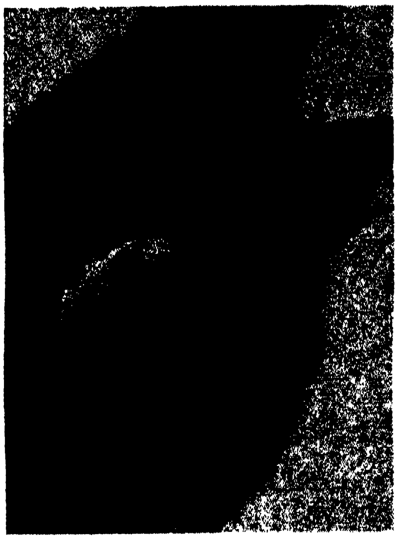
of a ball, with its prickly armament standing on end. By this means it usually succeeds in defying its enemies, although a simple method of making it uncurl is to roll it into some water, or direct a jet of liquid into the small opening left where the head, legs, and the margins of the body-skin meet

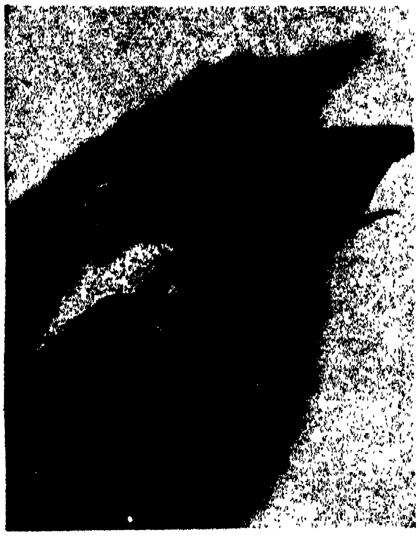
The common porcupine will sometimes roll itself up into a ball when threatened by a foe, but more frequently than otherwise it will take the offensive by rushing backwards and endeavouring to thrust the point of its sharp quills into the flesh of its enemy. The ancient belief, however, that the creature shoots out its quills like arrows is quite erroneous, the mistake probably having arisen from the fact that the weapons are but loosely attached to the porcupine's skin, and may occasionally become detached and sent flying through the air for a short distance when the animal is delivering an attack on one of its enemies.

Even among the fish we have in the globe fishes some creatures that protect themselves by means of their spines. Under normal conditions these lie flat against the skin, but when alarmed the fish inflate their bodies with air, the skin thereby becoming taut, and the spines erect. When thus distended they rise to the surface of the water and float upside down. Although by this ruse they may manage to elude those fish that seek to prey upon them, they are then easily captured by human enemies, some of whom, it has been stated, will amuse themselves by the stupid and brutal practice of jumping upon the captives so as to have the pleasure of hearing them explode.


The adult frog-hopper


The frog-hopper magnified five diameters


First stages of cuckoo-spit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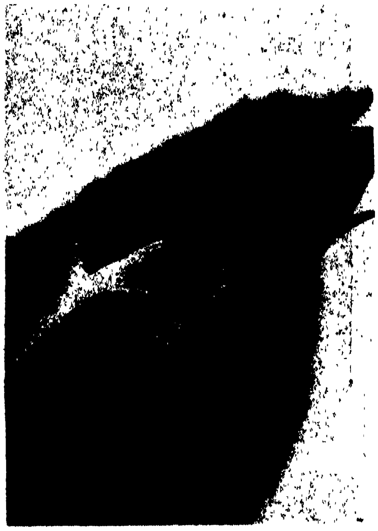
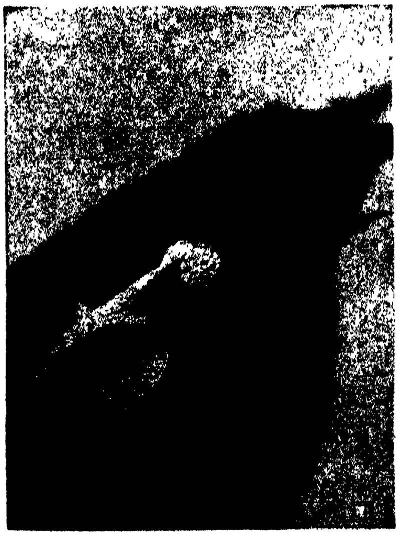

Half an hour from the start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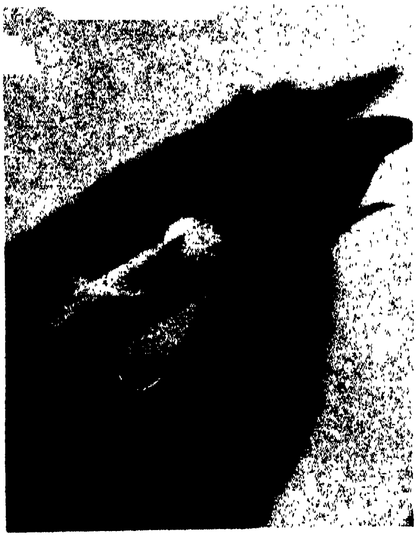
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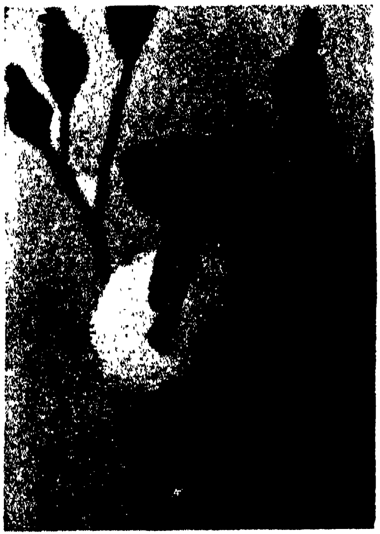
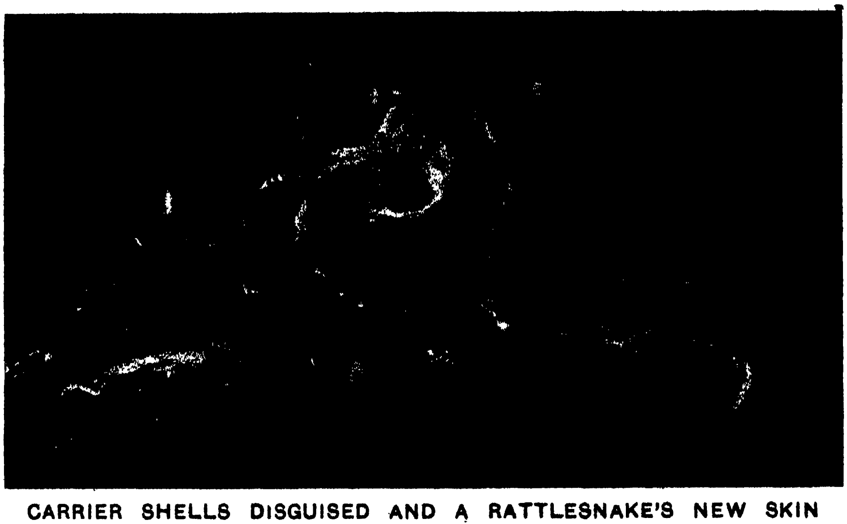

J. J. Ward

The frog-hopper leaving the froth

FROG-HOPPER OR CUCKOO-SPIT INSECT AND ITS NURSERY OF BUBBLES

Familiar to those who have gardens is the appearance, in spring, of a small mass of froth on the stems of various plants. This froth is exuded by the larva of the garden frog-hopper familiarly called the cuckoo-spit. The frog-hopper is equipped with a pair of strong hind legs which enable it to jump very strongly, and it lays its eggs in the stems of plants during the autumn, and in the spring the larvae hatch. In an hour, as we see here, one of these little grubs can surround itself with a mass of bubbles. It emerges quite dry.



CARRIER SHELLS DISGUISED AND A RATTLESNAKE'S NEW SKIN

The carrier shells have sought disguise by collecting other shells and covering themselves with a collection of these so as to seem something else than what they really are. The top photograph shows a rattlesnake which has just cast its old skin and emerged with a new one. In other words, the snake has grown out of its old suit and fitted itself with a larger size.

The expansion of the body as a means of self-preservation is also practised by the South American barking frogs. They blow themselves out to an enormous size, at the same time often uttering deep-toned notes, and sometimes emitting sounds like the wailing of a baby. Curiously enough, however, other frogs and toads will act in just the reverse manner, and when frightened will make themselves as small and inconspicuous as possible by expelling a quantity of water through the pores of their skin.

The soft-shelled tortoise is yet another creature that distends itself as a means of evading capture. Discovered in East Africa in the year 1920, this interesting reptile possesses a hard, dome-shaped shell when young, but, as it grows up, the carapace becomes quite flat, and so soft as to yield to the pressure of one's fingers. It hides between the crevices of rocks, wedging itself so tightly within its shelter by inflating its body with air, that it can only be dislodged with difficulty, and by the application of considerable force. But we have yet to mention a further method by which wild animals seek protection from their enemies, namely, that of placing sentinels to keep a look-out for danger. The baboons will act in this way, and in cultivated districts when a number of the animals are

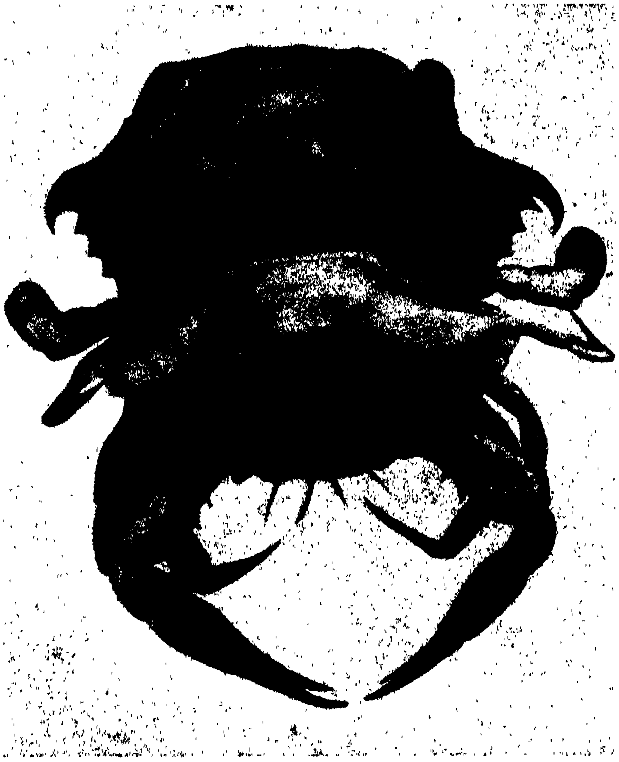
engaged in robbing an orchard, or stealing some other crop, they invariably depute several individuals to take up their stations at points of vantage, so that they may be ready to give warning to their companions should any danger threaten to disturb their proceedings.

A herd of kiang, or Tibetan wild asses will also be guarded by an individual who stands apart from the others while they are grazing ; while the little prairie marmots, or prairie dogs are other animals that do sentinel duty.

It has been stated in all seriousness that cranes will depute one of the flock to act as a guard at night while the remainder go to sleep, the guardian standing upon one leg, and clasping a large stone in the disengaged foot. Should the watcher get sleepy during its vigil, the foot relaxes its hold upon the stone which, falling to the ground, causes such a clatter as to immediately arouse the negligent bird. We regret to say, however, that this wonderful story cannot be accepted as being true.

The habits of the common fox, the squirrel, and the rabbit must not be overlooked under our heading, for they certainly display great ingenuity and watchfulness in evading their foes. As is well known, the latter will stamp upon the ground with its hind legs when it scents danger, the warning signal being at once answered by all others within hearing, who quickly scamper off to the shelter of their burrows ; while a squirrel that has been disturbed when feeding upon the ground will immediately clamber up the bough of a tree, keeping the trunk between itself and its enemy until it is finally lost to view amidst the foliage of the upper branches.

The cunning of the fox is displayed in various ways, and many artful tricks it resorts to for the purpose of outwitting its foes. After having robbed a hen roost, it will return to its lair by a circuitous route, and it is canny enough not to visit the fowl houses in the immediate vicinity of its home. When chased by a pack of hounds, moreover, it has been known to intermingle with a flock of sheep ; while an individual has also been seen to perform the rather wonderful feat of running along the top of a newly clipped hedge in an endeavour to put the hounds off its scent and save its harassed life.



Otho Webb

THE WAY OF A CRAB WITH ITS SHELL

Every so often the growing crab becomes too large for its shell. At last the old shell splits and the crab emerges in a new one, which is quite soft, but hardens in time (bottom). Thus a so-called "soft-shelled" crab is one which has just gone through this process. Above is a hermit crab which, having no proper shell of its own, lives in the discarded shell of some other creature.

Autotype

SURVIVORS OF THE EARLIEST FORM OF MAMMALIAN LIFE: A GROUP OF KANGAROOS

Isolation from the rest of the world at an early period in the history of mammalian development is the secret of the marsupials' supremacy in Australia. At a time remote from the beginnings of human history, though comparatively recent so far as geology is concerned, the connection which seems to have existed between Australia and Asia was overwhelmed by the sea, leaving a chain of islands—now included under the term Malaysia—like the piers of a broken bridge. As a result, the early mammal forms which had already reached Australia were cut off from competition with the more advanced types that developed later, and survive to this day as living representatives of what are only fossil animals in other parts of the globe.

Chapter LXXXVIII

A Land of Living Fossils

By Frank Finn

Author of "The World's Birds"

"ADVANCE, Australia," is the man-made motto of the southern Commonwealth, and white-man-made at that; under Nature's dispensation Australia has been a scene of something very like stagnation—a sort of biological backwater and almshouse for antiquated animals.

The land of the world as a whole is concentrated in a practically continuous mass in the northern hemisphere, split by the mere crack of Bering Strait, the southern hemisphere containing only the great peninsulas of Africa and South America and a number of islands, chief of which is Australia, which ranks as a continent in itself.

The struggle for existence has been hardest north of the line, and many of the types of animals once inhabiting this hemisphere have gradually, by ice ages, desiccation and other causes, been forced southwards into the peninsulas and islands aforesaid.

The fauna of Europe in the Stone Age was, to a great extent, African; lions, hyenas, and even rhinoceroses, elephants and hippopotami existed—types all now pushed south. The lion lingered until Alexander's time at least.

The process is still going on in India, where chimpanzees, hippopotami, giraffes and ostriches once lived, and the lion, cheetah, and caracal still linger on, but in the case of the first two, are on the verge of extinction. Human animosity has had much to do with this in the case of the lion, but not in that of the African types found fossil in the Indian region.

Earlier still, monkeys and parrots existed in France, where marsupials of the type of the American opossums have been found fossil, these opossums being almost the only marsupials now found outside the Australian region, and one of them, the most widely-ranging and successful of all the pouch-bearing beasts, still living in the north temperate zone as well as in South America.

Before this again, marsupials, or marsupial-like beasts of the Australian type, occurred even in the British Isles, and some Australian-like marsupials have indeed been found living, though as great rarities, in South America.

AUSTRALIA, being the most out-of-the-way corner of all the southern lands, and cut off comparatively early in the history of the higher backboned animals, though late in the long ages of geology, has become the refuge of the destitute, which have long enjoyed there a measure of prosperity which is only now being menaced.

For when a country is cut off by sea, invasion by animal competitors becomes difficult, the active animal being in many ways at a disadvantage in overseas distribution as compared with the passive plant. Seeds may be carried by the wind, even when not adapted by wings or plumes for wind dispersal, as we see in the unfailing appearance of chickweed and the little wayside grass in flower-pots and window-boxes in towns; many, like the coconut, will bear flotation for long distances even on sea water; some adhere to the plumage of birds, others may be transported in mud clinging to their feet when leaving the margins of water; but few but minute and low forms of animal life can travel in this way.

The highest animals are the worst off in this respect; their volition hinders their dispersal, for none would willingly swim far out to sea, and even birds and bats have got to new homes overseas by being blown there rather than by voluntary exploring flights, a good case of this being an invasion of America by storm-driven flocks of lapwings. The insects are more on the level of the plants in this respect, being very liable to wind-carriage, while molluscs can adhere to the feet of birds.

Then, when an animal has landed in a new country, unlike the plant which lives on soil and air, it is faced with the problem of "making good," and this is the harder the higher its organization. Early visitors to the Falkland Islands which, if not oceanic, are at any rate rather far from the mainland, noted that the local fox-wolf, now exterminated by man, and the only large mammal ever found in a remote island, appeared to suffer much from famine during part of the year, and island forms of the Sambar deer in the East Indies are dwarfed to half the size of the mainland type. The lapwings, above mentioned also, having struck the New World too far north and in winter, appear to have perished there.

SO, once cut off in Australia, marsupials were protected from most rivals and had for their only invading competitors rodents. These are far more numerous in species there than would be gathered from what is stated even in the best scientific works. There are more species than in Europe, in fact; but these include none of the rodent aristocracy that Europe can show—porcupine, hare, beaver, squirrel, jerboa—but all belong to the same family as rats and mice, which have, now that man has come upon the scene as a new agent for distribution, shown themselves the best fitted of beasts to colonise new areas.

Rats and mice, with the storage instinct which leads them to lay up hoards of food in holes, and their omnivorous habits, might conceivably drift long distances on trees uprooted by cyclone or flood, and thus be less easily cut off by sea than their betters. But even among these rodents Australia has thrown off two distinctive types: the conilures or hopping rats, miniatures of some of their marsupial fellow-countrymen, and the beaver-rats, which would be better called otter-rats, for both in form and

MARSUPIAL METHOD OF CARRYING THE YOUNG

The order of animals called marsupials derive their name from a Latin word meaning a pouch. It is primarily this organ that differentiates the members of the order from the rest of the mammalia. The kangaroo is only about one inch long at birth—or from the mammalian point of view, is born prematurely—and continues its development in the marsupium or pouch.

in their feeding-habits they are more like otters than like their rodent relative the beaver.

The dingo, or Australian dog, remains to be accounted for, and in his case human introduction is suspected ; at any rate, no doubt by virtue of superior activity and cunning, he appears to have driven out the two most powerful of the carnivorous marsupials, the thylacine, or marsupial wolf and the Tasmanian devil Their Australian fossil representatives were larger, and perhaps the striped carnivore, big and fierce enough to kill a fighting staghound, which is reported from the thick bush of Northern Australia which the dingo cannot colonise, may turn out to be the old Australian thylacine.

It is among the carnivorous section of the pouched animals that the most interesting of Australian marsupials is to be found—the little squirrel-like banded anteater, which has teeth exactly like some of the small mammals—presumably marsupial—which existed in Europe when the reptile class was in power, and mammals had not got beyond the simple rat-shaped type, which remains the commonest among the mammalian class to-day; while any sort of mammal, if traced back far enough in the fossil fauna, becomes more and more rat-like.

This beast has no pouch, the family sporran being by no means a universal possession among marsupials, whose young, born as it were prematurely and exceedingly small, hang on to the teats of their mother by their specially modified mouths, and so are to a very great extent independent of it.

The other carnivorous marsupials represent the smaller carnivores, such as the weasel tribe, and the insectivores, in Australian animal life ; such are the " native cats," spotted animals which remind one of the martens of the north in form and habits, the tapoa tafa, generally rather absurdly called " brush-tailed pouched mouse " —" pouched stoat " would give a better idea of it—and a number of small " pouched mice," which are rather pouched shrews in their attributes. The curious pouched mole, a recent discovery, has a family to itself in this section. The bandicoots, which evidently got their name from the large bandicoot rat of India, approach the vegetarian marsupials in some ways, being largely vegetable feeders and having the peculiarity of the vegetarian marsupial's foot, the enclosure of the second and third toes in a common skin so that they seem to be one toe with a double claw, a peculiarity unique in mammals.

This family has thrown off one of the quaintest little oddities in the mammalian class—the pig-footed bandicoot, which has a shrew's nose, rabbit's ears, and the long slim legs of the hoofed animals, and mimics two leading groups of these by going on two toes in the fore feet and on one in the hind feet.

Autotype

BENNETT'S WALLABY, AND THE GREAT KANGAROO POISED FOR A JUMP

Found in the denser scrub of Australia and Tasmania and also in New Guinea, the wallabies, of which there are several specimens, are smaller than the typical kangaroos and are also more brightly tinged as to the fur. The specimen seen here (bottom) belongs to the species known as Bennett's wallaby. Above is the great kangaroo, which may weigh twelve stone and be five feet tall. The kangaroos represent the cloven-hoofed family of other parts of the world, being found in the open, feeding on herbage or else among the woods, according to species.

TREE KANGAROO UP AMONG THE BRANCHES

Tree kangaroos are found in the northern parts of Australia and in New Guinea. They are chiefly differentiated from the ground kangaroos by the structure of the fore limbs. These are very strong and nearly as large as the hind limbs, being used in climbing. These kangaroos spend the day in the tree tops coming down at dusk to feed upon ferns and other vegetation.

Less remarkable, but still a nightmare sort of beast, is the rabbit-bandicoot or "native rabbit," which is like a rabbit with a long nose and tail. This is said to hop on its hind legs, a habit so well known in the case of the kangaroos, the most familiar of marsupials to us, that it probably looms too large in the popular conception of a marsupial. The kangaroos are, indeed, the most numerous family not only of the vegetarian marsupials, but of the whole pouched group, but they do not all have long hind legs, and the shorter-legged kinds, like the tree kangaroos and potoroos, or kangaroo-rats, for example, go on all fours.

The larger kangaroos we know best take in Australia the place of the cloven-hoofed animals of other countries, and are very like them in habits, being polygamous, grazing, and browsing herders. They bring forth single young, and attain greater speed in the females than in the males. They also similarly occupy different stations, some being woodlanders like deer, others living in the open like antelopes, or on the mountains like goats; while at least one frequents low-lying land subject to floods, hopping quite happily through shallow water and crossing rivers of considerable width, freely.

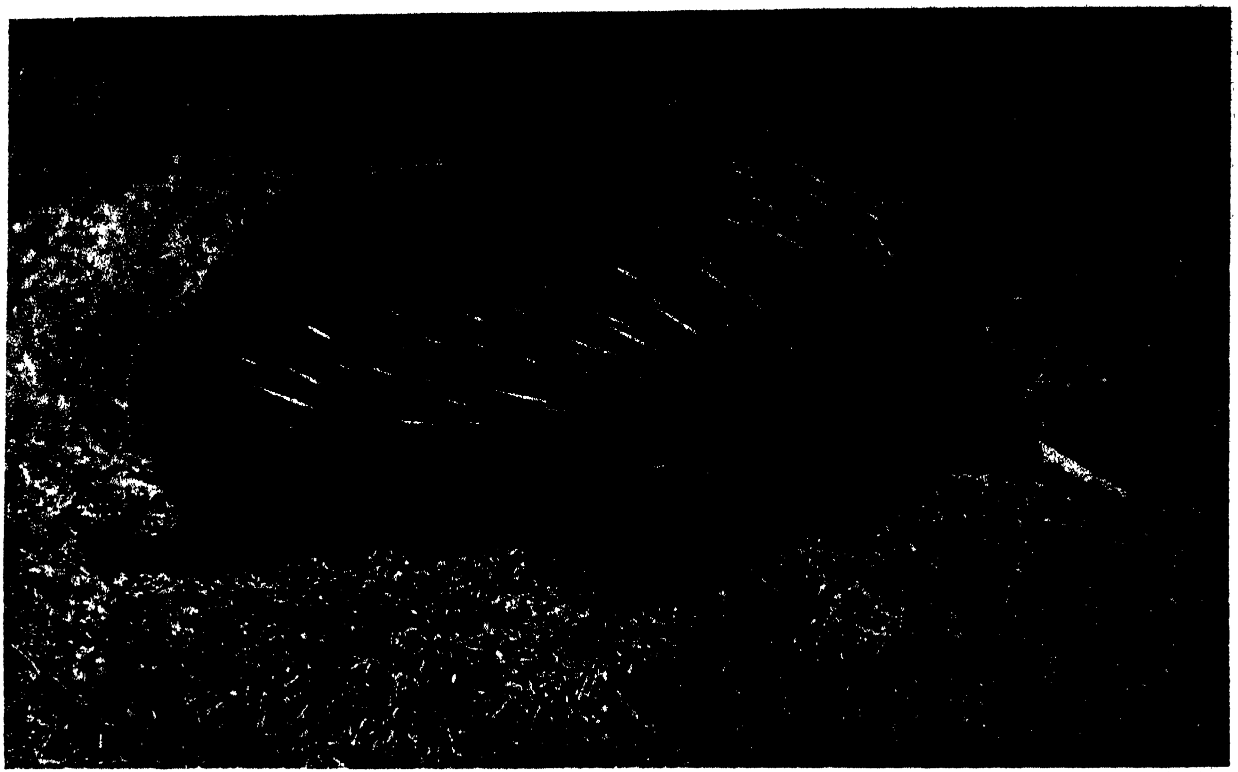
Some of the smaller kinds are very like hares in their habits, and in this, too, they resemble the cloven-footed beasts, which also tend to be hare-like in their ways when of small size. The potoroos not only go on all fours, but actually burrow in the ground like rabbits.

The tree-kangaroos rather give one the impression of animals which have comparatively recently left the ground for the trees; but there is one kangaroo, the smallest of all, which is more adapted to a tree life, though it actually lives mostly on the ground. This is the rat-like musk-kangaroo, which, unlike all the others, possesses the first toe on the hind foot, and this so placed that it is capable of grasping, and also has one curious twisted grinder in the jaw which is characteristic of the great family of phalangers, or opossums as Australians call them. Like them, too, it lives on soft vegetable food, and takes animal nutriment also, eating palm-berries, roots, worms, and insects. The phalangers are all climbers, and, like climbing animals generally, usually eat some animal food, though belonging to the vegetarian section of the order. But the largest, and the only tailless one, the koala or "native bear," seems to be not only purely vegetarian, but very specialised in diet, living almost entirely on eucalyptus leaves. Specimens exhibited in the London Zoo walked, when on the ground, like true bears but with the fore-paws turned out instead of in.

The typical long-tailed phalangers are very like lemurs or squirrels in their ways, and most have developed on flying-squirrel lines, having a flounce of

AUSTRALIAN OPOSSUMS THAT SPEND THEIR LIVES IN THE TREES

In Australia phalangers are called opossums, and in this page we have two examples. The lower photograph is of a lesser flying opossum, one of the members of this family which has grown a special piece of expanding skin on its flanks. This is outspread when the animal is leaping from tree to tree and enables it to make long glides through the air. The upper photograph shows a short eared opossum sprawled out upon a tree trunk. Its outspread position is due to the fact that it is reaching as far as possible with both paws to get a good grip.



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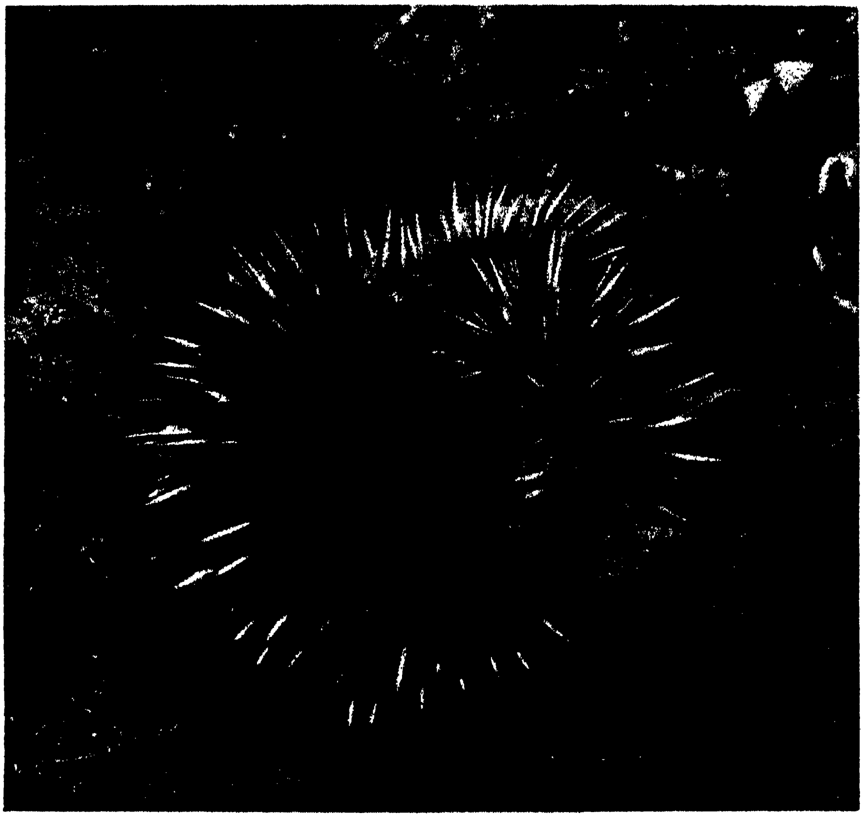


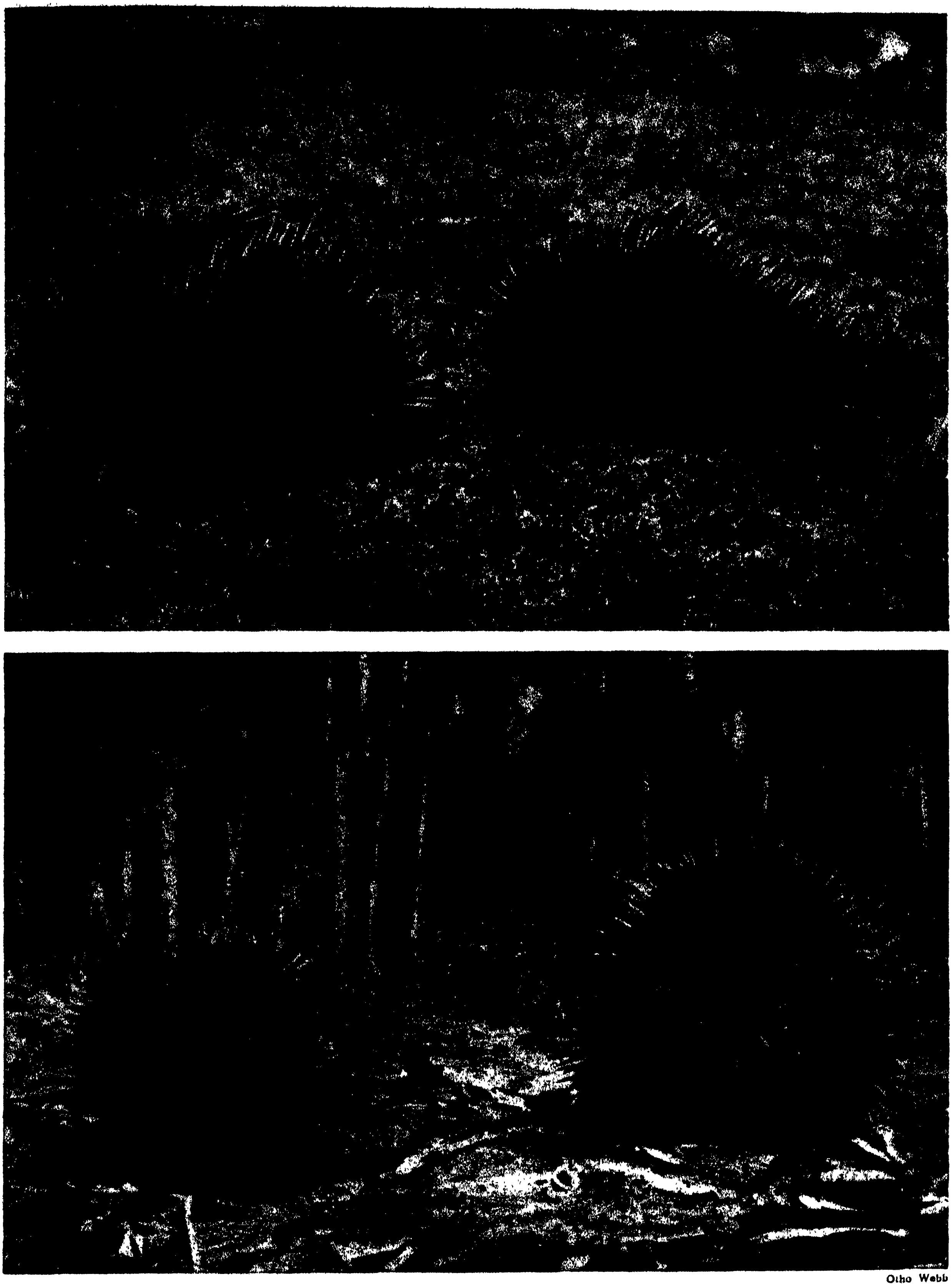
Otho Webb

AUSTRALIA'S STRANGE ECHIDNA, OR SPINY ANT-EATER

In the lower photograph this strange-looking ant-eater has been rolled over on its back to show the long snout and the strong digging claws, which are all used for raiding ants' nests. The echidna is equipped with a special prehensile tongue for collecting ants. The hair of the body is mingled with short, strong spines and the spines are often so thickly set as to obscure the hair

skin along their sides by which they can glide for many yards. There is a very quaint little oddity in this family, too, the honey-sucking tarsipes, called noolbenger by the Blackfellows, which has a long nose and tongue, though, like the mice it resembles in size and general shape, its food also consists of insects.

The wombats form a very remarkable family with only a few species. They are tailless and have the size and burrowing habits of badgers but the gnawing ways and few incisors of rodents. They are not found outside Australia and Tasmania, and the kangaroos only extend into the Aru Islands and New Guinea; but the phalangers range west even to Celebes, where two species of the non-parachuting cuscus group hang on to territory where higher mammals such as pigs and apes are found invading the Australian region, which is separated from the Oriental by " Wallace's Line," the narrow sea running between Celebes and Borneo, and lower



Otho Webb

QUEER MAMMALS THAT LAY EGGS AND GO COVERED IN SPINES

As a rule the echidna does not roll itself up (bottom) if there is time for it to bury itself. It is seldom seen by day, but makes its appearance during the evening and is active through the night when it robs ants' nests. As it moves over the ground its gait is seen to be rather a shuffling one. The female lays eggs and these develop in the pouch with which, like the other marsupials, she is equipped. The young are suckled and carried about in the pouch for some time after birth. In the top picture the echidna's long snout can be seen.

KOALA, A VEGETARIAN CLOTHED IN THICK GREY FUR

Almost the most attractive of Australia's unique fauna is the koala. It looks rather like a teddy-bear, is about the size of a poodle when full-grown and related to the wombat. The fur is very thick and woolly, grey on the back, yellow-white on the hind quarters and white on the belly. The cheeks are pouched for the storage of food.

down narrowing to a mere strait between the two little islands of Bali and Lombok.

The vegetarian marsupials have never been found outside this area, but two little animals, survivors of an anciently-extinct family, linger in South America and connect the vegetarian and carnivorous sections, having the single pair of large incisors in the lower jaw of the former, and the free second and third hind toes and large upper canines of the latter.

This, and the presence of marsupials of the Australian carnivorous type in South America, may show that there was once a land connexion between these two continents, or may merely be evidence of the former universal distribution of the pouch-bearers. Early and comparatively lowly-organized as these pouched beasts are, they do not represent a stage through which the higher mammals passed, but rather a strong side-limb, given off very low down, of the mammalian tree, which branch, having found a chance to develop unchecked in the Australian corner, has repeated in its growth, as we have seen, many features of the main tree. Like this, too, it has its dead branches, for in Australia, as elsewhere, there has been the usual outbreak of "gigantism," or the production of giant species, which the whales display at present. Such species have poor endurance as a rule, and so generally become extinct. The thylacine and "devil" of the Australian mainland were not sensationally larger than the living species, but the vegetarians have bred some monsters. A kangaroo with a skull a foot long and a wombat as big as a pony must have been imposing beasts, but were as nothing compared with the diprotodon, which was a great clumsy bear-shaped brute as big as a rhinoceros, with two great incisors in each jaw.

Stranger still was *Thylacoleo carnifex*—the "butchering pouched lion," to translate the name Owen gave it. Though small compared with diprotodon, it was a big beast, with the orbits of the eyes surrounded by bone as in ourselves and so many other highly-developed mammals, and with a most puzzling set of teeth—two pointed incisors in each jaw, no canines, and the other teeth not amounting to much except for a huge narrow, square-cut grinder on each side, quite unlike any tooth possessed by any other beast living or extinct; though it must be admitted that several marsupials, in being, or bygone, which have the single pair of incisors below, do have a large narrow grinder; but this, like the great "carnassial" grinder of the higher carnivores, is arched, not squared, at the top.

WHAT the thylacoleo did with this dire dentition we do not know; Owen thought it was a dreadful carnivore, and named it accordingly. But it was a phalanger, and should have been vegetarian, though the vegetarianism of the lower animals is seldom

KOALA THAT LEADS A COMFORTABLE, EASY LIFE IN THE TOPS OF HIGH TREES

Confined to Eastern Australia, the koala is an arboreal beast only occasionally descending to the ground. It feeds almost exclusively on eucalyptus shoots, moving about the tree-tops in a very leisurely manner. Most of the day is spent in sleep in some hollow of a tree, though the animal is not averse to sunning itself when it can find a really comfortable arrangement of branches, as here. Note the position of the hind limbs which are so hunched up as to touch the fore-limbs. If interfered with the koala screams loudly.

consistent, as we see with rats and pigs, and it is said that bones have been found bearing marks that would be produced by the thylacoleo's teeth. This might not prove it to be a carnivore, since the vegetarian porcupine is fond of gnawing bones, and deer fairly eat them up ; but it may be suggested that the beast was partly a scavenger, and cracked and swallowed bones like the hyena, leaving its stomach to settle matters with the bits. At any rate, it must have been a fearsome-looking beast, in the face, much like the jabberwock in " Alice " and may yet turn up in New Guinea, since tales come thence of a creature which leaves footprints as big as a bullock's and has " a face like the devil."

THE reason for these casualties in bygone Australian animal life is no doubt the climate which, unlike competitors, cannot be escaped by isolation. Australia was doubtless once less droughty than it is now, but droughts are always likely to occur, and large, heavy animals will make their own droughts by eating off herbage wholesale and then exposing the soil, which, trampled into dust, blows into water and silts it up. Our introduced stock are doing this at the present day, and thus repeating what the old large animals probably did. The carnivores must disappear with their prey, and ultimately the small animals, so much more frugal and prolific, win through, just as the rabbit scores off the sheep.

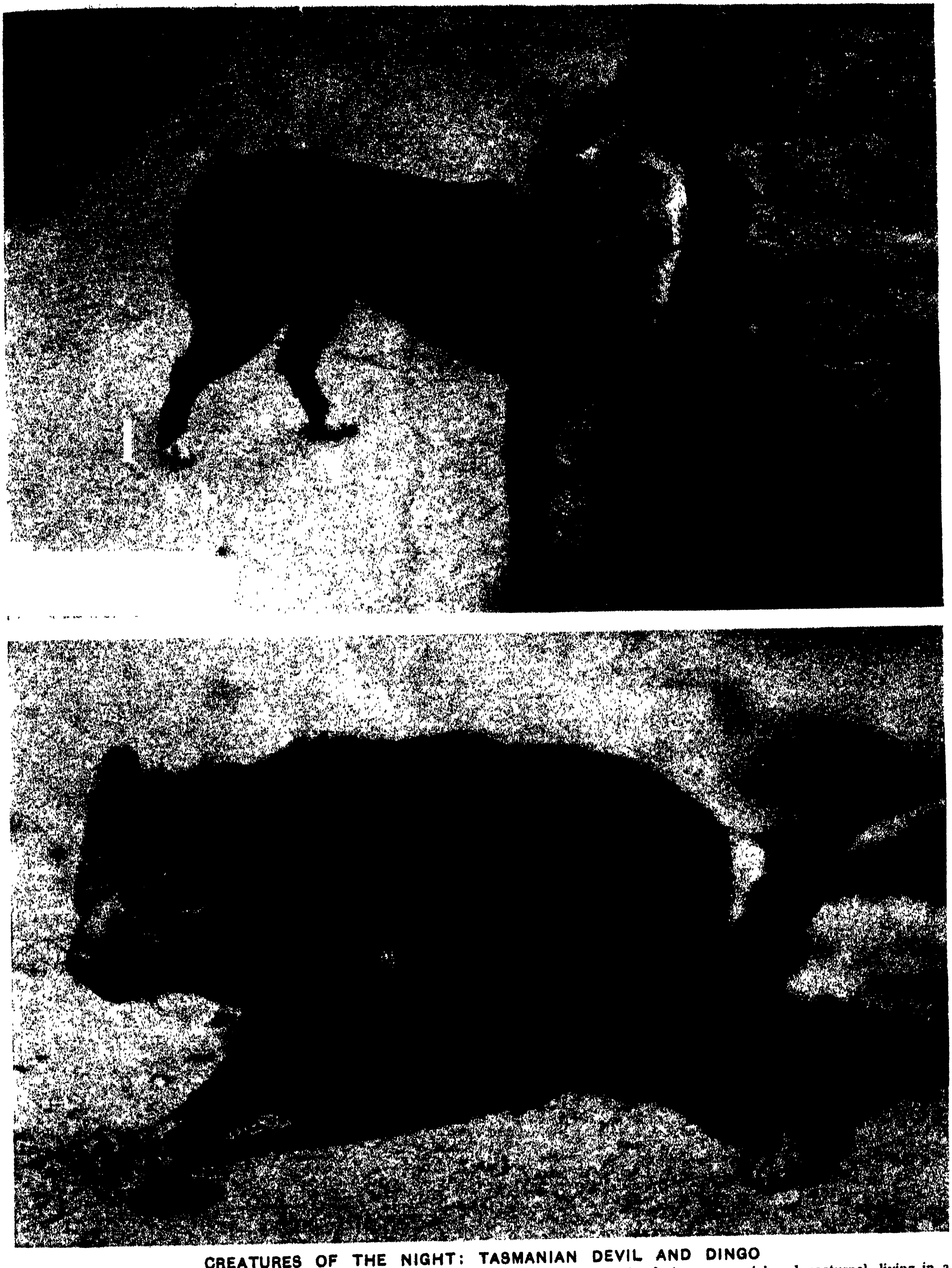
Circumstantial evidence of the extinction process was furnished by the discovery of a large number of diprotodon skeletons in a salt marsh which is even now dangerous to cattle.

The danger of crossing soft ground, always present for most large animals, is intensified by drought, when the borders of water become stretches of mud, and bogged and drowned animals poison the remaining supply. Moreover, marsupials, like so many other animals, have their epidemics ; the charming koala, from being a common animal, has become rare through this cause, and epidemics are more dangerous to the existence of large species, owing to their smaller number of individuals as compared with small ones. Interesting scientifically as the marsupials are, they

Mondiale

SPOTTED NATIVE CAT AND AN OPOSSUM OF UNCLASSIFIED SPECIES

The large, carnivorous marsupials have disappeared from the mainland of Australia though they still maintain a precarious living in Tasmania. The native cats, or dasyures, however, still keep a footing on the mainland. They are arboreal and seem to take the place of the martens of Europe, whose general habits those of the dasyures much resemble. The lower photograph is of one of these animals, while above is an unclassified species of opossum, very ratlike, found in the wild country of the Northern Territory.



CREATURES OF THE NIGHT: TASMANIAN DEVIL AND DINGO

A bane to the sheep farmer, the Tasmanian devil (bottom) has been remorselessly hunted. It is a marsupial and nocturnal, living in a burrow like a badger. Indeed, it seems quite blinded if exposed to the full glare of the sun and only comes out at night. It usually grows to a little over two feet, the tail adding another foot to its length. The upper photograph is of a dingo, the handsome wild dog of Australia. It is usually found solitary and is nocturnal like the Tasmanian devil. The colour varies between black and grey-red.

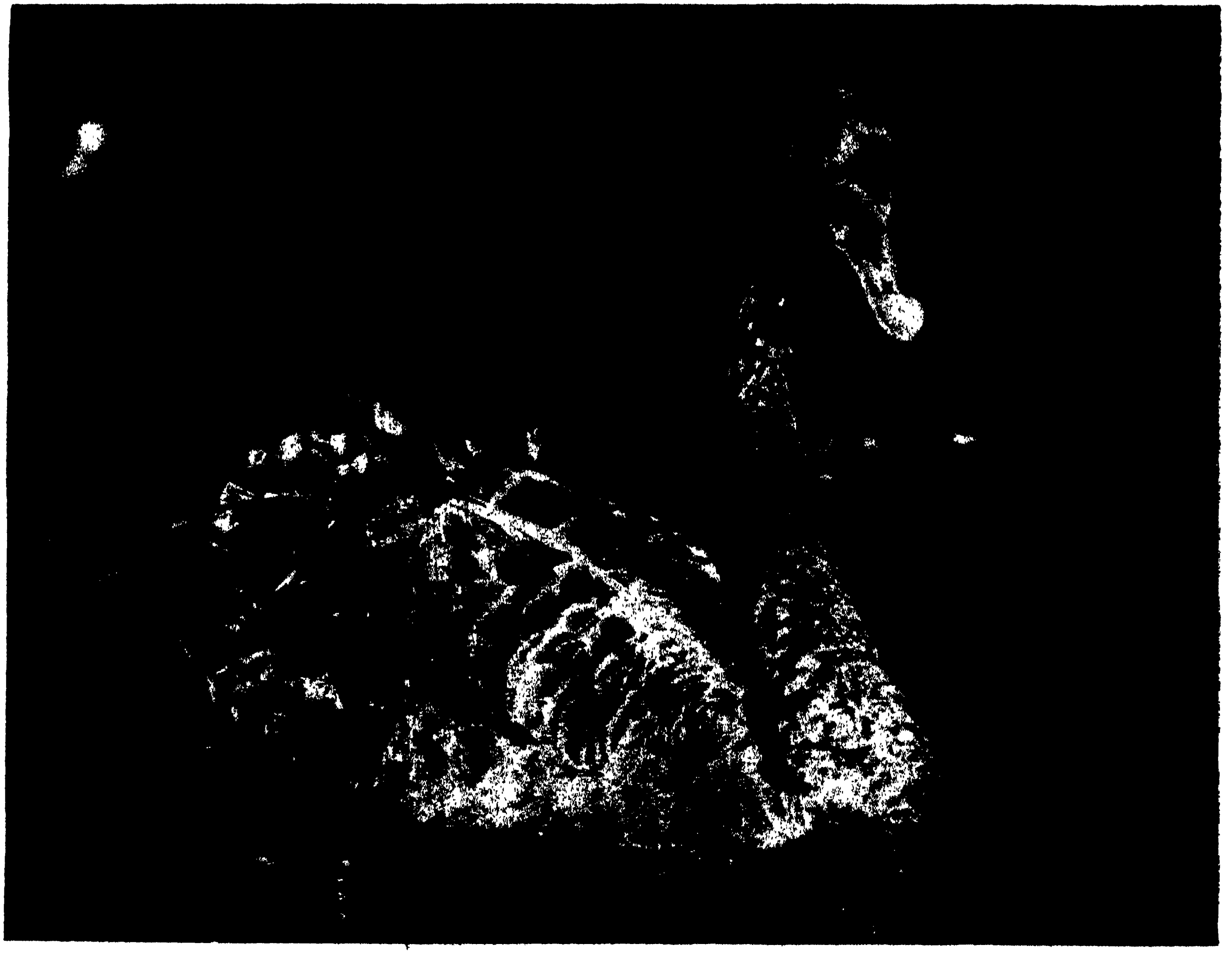
DUCKBILL AT ITS NEST AND THE TASMANIAN WOLF

Probably the weirdest of all living animals is the duckbill. It is about eighteen inches long, covered in fur, suckles its young, and goes on four short legs whose feet are webbed. It has a duck-like beak and lays eggs. The duckbill seems to be a survival from the time when there was an animal, half reptile, half mammal, which had got as far in evolution as to have hair instead of scales or feathers and to suckle its young, but had not yet given up laying eggs in favour of bearing its progeny alive. Above is a Tasmanian wolf.

PAIR OF BURROWING WOMBATS AND A RING-TAILED OPOSSUM

While kangaroos are found in New Guinea wombats (bottom) are entirely confined to Australia and Tasmania. There are only four species, and the animals are about two feet in length and rather bear-like in appearance. They burrow like badgers and live on roots and grass, but have the gnawing teeth of rats and rabbits. The fur is thick and coarse and may be yellowish-brown, dark brown or black. Above is a ring-tailed opossum in a characteristically acrobatic pose on a branch. It is holding on by all four legs at once.

Smithsonian Report



AUSTRALIA'S UNIQUE BLACK SWAN AND LYRE BIRD

Nowhere else in the world has there arisen a black swan. This bird of sombre plumage is native only to Australia, although specimens have been often exported to grace ornamental waters in Europe. The beak is red and the under sides of the wings white. The upper photograph shows one of the beautiful lyre birds found in the denser parts of the forests of Australia. These birds seldom fly, and pick up their food, insects and worms, on the ground, but are very quick runners.

are commonplace compared with the monotremes, or single-vented mammals, the most celebrated of which is the well-known duckbill, or platypus. This is confined to Australia and Tasmania; but New Guinea as well as these countries can show examples of the other monotreme type, that of the echidna, or spiny ant-eater. Both duckbill and echidna reproduce by laying eggs.

The interest of these animals lies in the fact that, though strongly specialised on lines of their own, they are in some ways really representative of a half-reptilian mammalian ancestor, which had got as far as growing hair and giving milk, but still laid eggs. They have no teats, but sweat out the milk from specialised patches of skin. The duckbill, which feeds on small water-animals in the manner of a duck, has true teeth when young, afterwards shed and replaced by horny ones. These first teeth are like those of some of the earliest mammals, though others of these have teeth more like marsupials. Possibly the teeth became differentiated before egg-laying was dropped in favour of live-bearing, but as the remains of early mammals are generally only jaws or at most skulls, they do not really tell us whether the beasts in question were marsupials or monotremes.

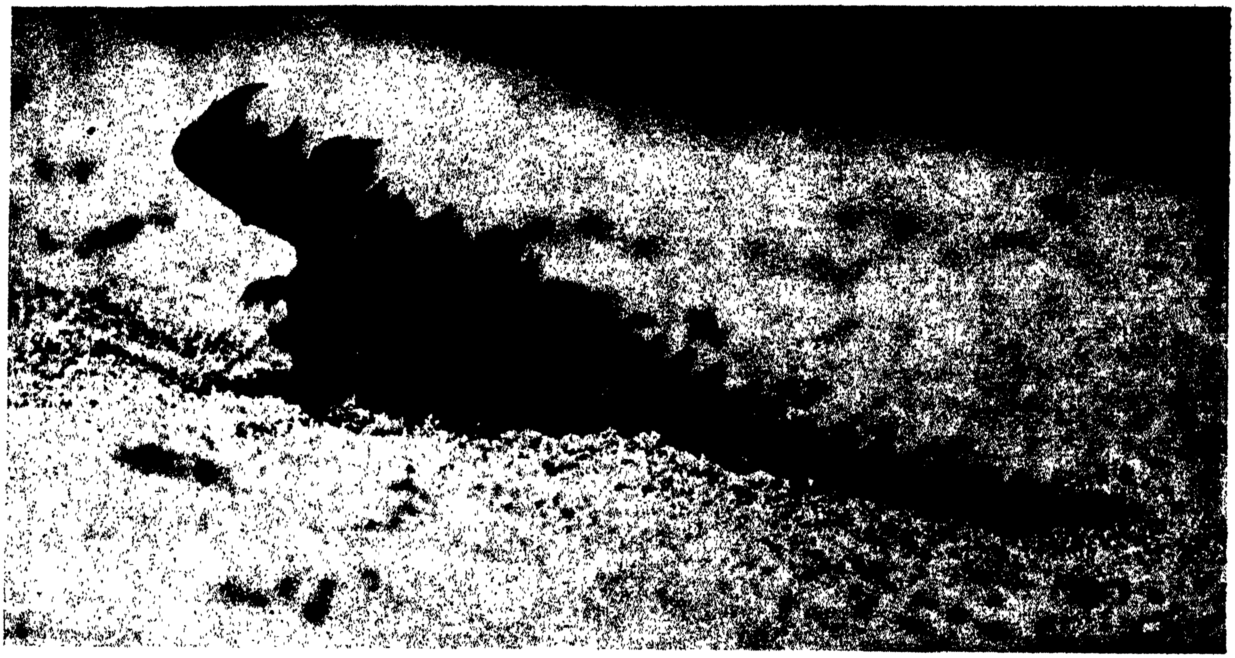
Considering their powers of locomotion through air, it is astonishing that the distribution of birds, and of bats among mammals, has run so closely parallel to that of ordinary beasts; Australia has bats, of course, but of quite ordinary type, like her seals and sea-lions. Among birds, in the emu and cassowary she has members of a group comparable to the marsupial mammals—lowly organized, but specialised as a side branch, and once quite generally distributed, but now nearly limited to the southern hemisphere. It is curious that the ostrich, the only species which is still found north of the line, belongs to the most primitive family, just as the only northern marsupial, the common American opossum, is one of the more primitive pouched mammals. The ostrich is more primitive than the emu and cassowary because it has the hip bones joined below as in reptiles and as in no other bird, and also it possesses much better developed wings, for these giant runners are simply birds that have made biped beasts of themselves by losing the power of flight.

FROGMOUTH THAT SLEEPS SOUNDLY ALL DAY

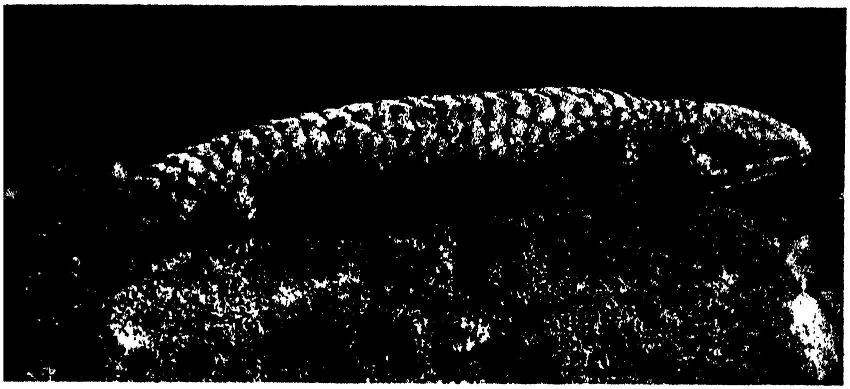
The Australian representatives of the night-jar family are known as "moreporks" because the sounds they utter are supposed to resemble the words "more pork." During the day the morepork, of which there are a number of species, sleeps so soundly (often in a hollow tree), that it may sometimes be taken off its perch by hand.

Australian birds generally seem to be rather comparable to Australian rodents—invaders of a very ancient period, often specialised, but often quite of ordinary type; and sometimes they are even much the same as European species.

They do, however, often show old peculiarities. Australia holds a bird which is evidently ancient, and shows us what the ancestor of the wild fowl family was like in some respects. This is the so-called magpie-goose, a bird so slim and leggy, and with the feet so



Neville Kingston



Chas. Barrett

LIZARDS OF FRIGHTFUL ASPECT BUT PEACEFUL HABIT

Australia is rich in lizards and among them are two whose appearance might make the boldest creature chary of approaching. The stump-tailed lizard (bottom) sleeps all day and comes out at night to feed on insects. If molested it gives a severe bite but is never aggressive. The moloch (top) is equally inoffensive though quite as ugly. The larger spines are hollow.

slightly webbed and so well adapted, with their long hind toes, for perching, that if its head were cut off no one who saw it for the first time would class it as one of the duck tribe, but as one of the heavier perching waders, probably an ibis. Yet it has never attracted attention, even from Darwin, who missed so little, while its compatriot, the black swan, which is no more remarkable scientifically than the white bear, is known to everyone.

PRIMITIVE also in their well-developed hind toes are the characteristic Australian game-birds, the megapodes, or mound-builders, of which the brush turkey can always be seen at the Zoo. These bury their eggs like reptiles, and their young, which are hatched with fledged wings, look after themselves at once just as young reptiles do. The range of these birds is nearly the same as that of the vegetarian marsupials.

The cold-blooded tribes, backboned or otherwise, have been so much longer upon the earth than beasts and birds that they have seen far greater changes, and their distribution rarely coincides with that of the two higher classes. Thus there is nothing remarkable about Australian reptiles, though in New Zealand we get the tuatera, a reptile of very ancient descent with some relationship to amphibians. Among Australian amphibians the interesting point is not the presence but the absence of primitive types, for the newts and salamanders, which represent the most primitive type not only of amphibians but of land vertebrates, nearly all live north of the line and never anywhere near Australia. As they are bad travellers on land, and need damp and coolness, they have never been able to retreat southwards. Frogs and toads are common enough in Australia, but these represent a comparatively modern group.

Fresh-water fish, however, are very much on the same footing as birds and beasts and the three great southern regions each have their own species of the primitive lung-fish which were abundant in the coal period. The Australian variety is in some ways the most primitive of any, with its flipper-like fins, the fins of the others being reduced like the wings of most of the great flightless birds.

We may regard the great southern continent as a region of refuge and toleration.

Chapter LXXXIX

How We Study Life Beneath the Sea

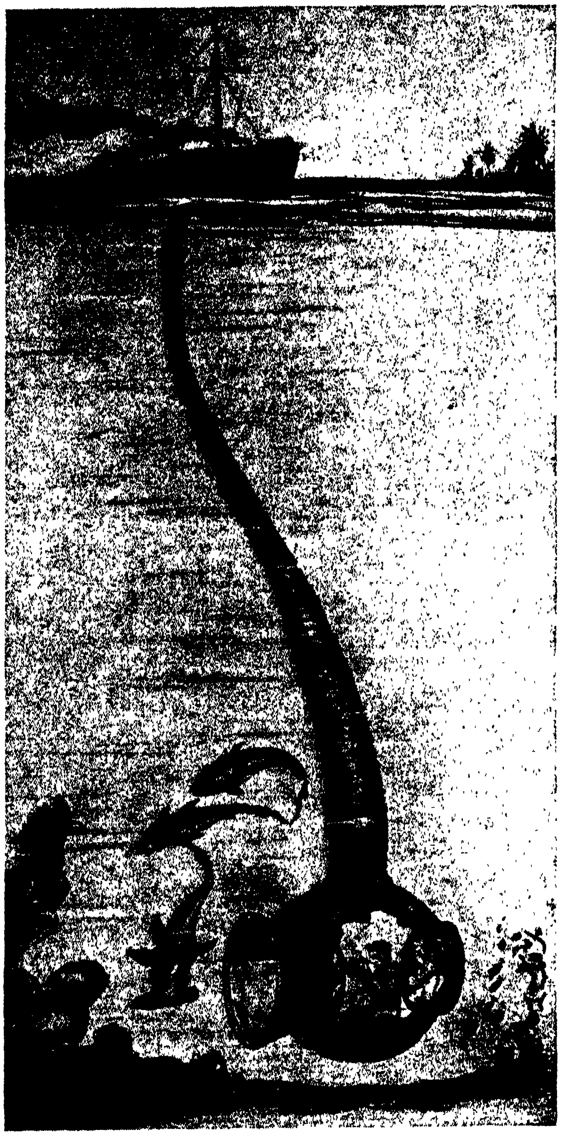
By G. A. Steven

Of the Marine Biological Laboratory, Plymouth

The sea covers over two-thirds of the earth's surface. According to recent estimates, its area is somewhere in the region of 140 million square miles, and it is believed to occupy a volume of between 300 million and 320 million cubic miles. This vast ocean world simply teems with living things of the most diverse forms and sizes, ranging from the largest known living animals, the whales, and the tallest plants, down to minute organisms

> Thick and numberless
> As the gay motes that people
> the sunbeams.

The scientific study of this wealth of marine life is of very recent origin, dating roughly from about the middle of last century when a few tentative voyages of exploration began to be made. Until this time it was believed even by the highest authorities that marine organisms were confined to depths of three hundred fathoms and less, and that all the vast sea world below that level was a sepulchral realm of absolute and everlasting calm and silence, permanent darkness, and intense cold in which no living thing could possibly exist. But in the year 1868 H.M.S. Lightning proved beyond all doubt the fallacy of this belief by dredging up from 650 fathoms a rich collection of marine animals, many of them wonderfully constructed organisms which had never before been seen. It was not, however, until the return of the famous Challenger expedition (1872–76), under the leadership of Sir Wyville Thomson, that the great "world below the brine" was clearly revealed. During her three and a half years' voyage of exploration the Challenger cruised over 68,900 nautical miles and dredged new and rare forms of life from 354 stations situated all over the ocean world, many hauls bringing up bizarre creatures from depths of over five miles.



HOW SUBMARINE PHOTOGRAPHS ARE TAKEN

In this sketch we see how photographs have been taken under the sea in the tropics by Mr. J. E. Williamson. The tube is made of flexible steel rings and the photographer sits in the observation-room at the lower end.

Since the days of the Challenger great strides have been made in oceanographical research—advances rendered possible by the ever-increasing number and greater efficiency of the mechanical appliances available in more recent years. One of the first contrivances designed for capturing marine organisms for purposes of scientific study seems to have been the dredge. This instrument is still in regular use and is likely to remain so. It is of simple construction, consisting of a stout rectangular frame of wrought iron, to which is attached a strongly-made bag or net. The dimensions of the frame depend upon the size of the vessel from which it is to be worked, and the mesh of the bag is varied according to the size of the animals it is desired to catch. The dredge is particularly suitable for use on rocky bottoms. Its sharpened edges effectively dislodge fixed forms, and are sufficiently strong to break off pieces of softer rock thus bringing to light those animals—such as brittle-stars and sea-cucumbers—which insinuate themselves into crevices. The dredge is also used on soft bottoms, where its digging action unearths worms, burrowing molluscs and certain crustaceans which live buried in mud or sand.

For capturing the animals which live on, or swim just above, the surface of smooth ground, trawling is the most effective method. Two types of trawl are commonly used, the beam trawl

ON EITHER SIDE OF THE GLASS: DIVER PICKS A BOUQUET BY REQUEST

The native diver has swum into the range of vision of the window and has made out by signs in this silent world under the sea that he is to pick a plant from this marine flower bed. One of the excitements of this submarine observation post is that one never knows what may suddenly swim into view or what comedy or tragedy may be played within the distance of a few feet. Tropic fish will live in an aquarium, but down here there are not only fish but the thrill of the unexpected.

and the otter trawl, the former being more suitable for use with sailing ships, and the latter with larger motor or steam vessels. The beam trawl consists of an elongated triangular flattened bag of strong net, the mouth of which may vary in breadth from 20 to 50 feet, and the length from 45 to 120 feet, according to the size of the vessel.

The upper edge of the mouth is straight and is fastened to a stout horizontal wooden beam, equipped at each end with a stirrup-shaped runner which keeps the beam raised about three feet above the sea bottom. The lower margin of the mouth is attached to a heavy " footrope " which is fastened at each end to the lower corner of the runner. This footrope is not tightly stretched, but curves backwards in a wide bight behind the level of the beam. As the trawl is towed along the sea floor the footrope drags heavily upon the ground, stirring up the animals thereon. These, prevented from escaping upwards by the forwardly projecting upper side of the net, are swept backwards into the apex or " cod-end." Everything on the sea floor is gathered up in the trawl—loose stones and other debris, seaweeds, invertebrate animals of all kinds, as well as fishes swimming just above the bottom.

In the more modern otter trawl the general shape and arrangement of net and footrope are the same as in the beam trawl, but the beam is replaced by a strong rope, the " headline," and the runners by heavy wooden " otter " boards like massive doors. Each board is shackled to the trawl-warp in such a manner that it moves forwards on one of its longest edges, with its surface set outwards at an angle of about twenty degrees to the direction in which the trawl is being towed. In this way the mouth of the net is kept open to its full extent—to which there is no limit other than that imposed by the size and displacement of the ship—simply by the kite-like action of the boards.

In another type of otter trawl which can be used by large and small vessels alike, the otter

SKETCHING NATURE FROM A WINDOW UNDER THE WAVES

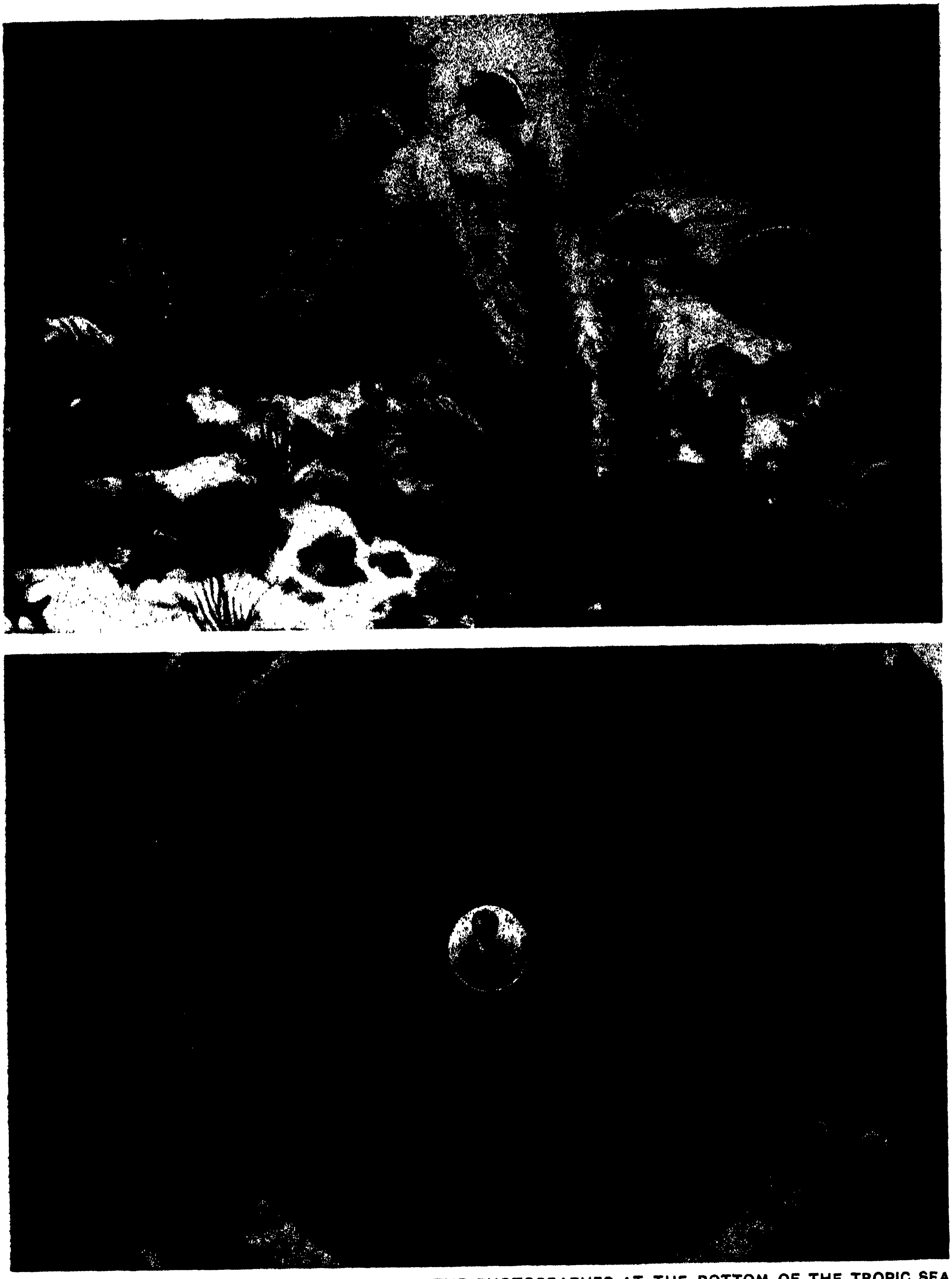
A new world has been opened up for the artist by this ingenious invention which allows a man to sit comfortably, fathoms below the surface, and watch as from a window the glinting fish as they swim by and catch the tropical rays from the blue skies above. We see the artist, Mrs. J. E. Williamson, pausing, pencil in hand and sketch on knee, to mark the forms and the lines of the strange creatures that move delicately poised in the wonderful transparent element on the other side of the plate-glass.

boards are replaced by patented dirigible otter boxes, which are open at each end and act after the manner of box kites. They can be adjusted to work at the surface, on the bottom, and at all intermediate depths—an important advantage which renders possible the capture, by trawling, of fishes and other animals which do not live on or near the sea bottom.

For work in very deep water the Agassiz trawl is used. This contrivance—devised by Professor Agassiz—is provided with two foot ropes and an iron frame so designed that it will fish effectively whichever side is uppermost. This is a very necessary quality for, in descending to great depths, the instrument is liable to turn over and over several times and will land quite as frequently on one side as on the other.

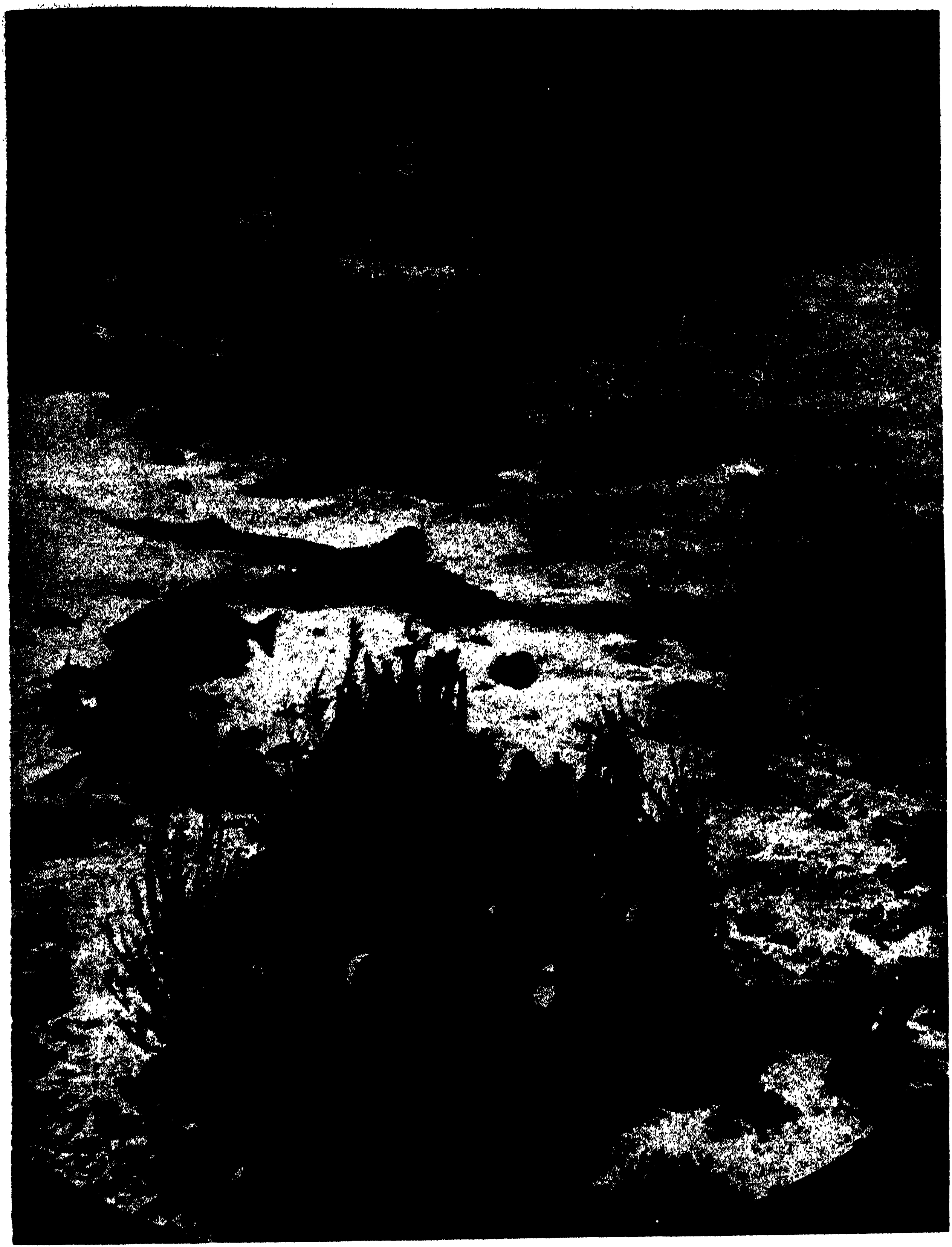
By the methods described above, the denizens of the deep can be caught for examination and description, but a quantitative estimate of their abundance cannot be obtained. To supply this information Dr. Petersen, a Danish zoologist, has designed an instrument now known as the "Petersen grab" which, working after the same manner as the well-known coal-grab, "bites" from the sea bottom a known area of sand or mud with its contained fauna. From the data furnished by a representative number of grab hauls the invertebrate population of a definite area of the sea bottom can be calculated. To estimate the fish population, however, is a more difficult matter which, up to the present, at any rate, can be attempted only by indirect methods.

Those plants and animals, many of them exceedingly small, which float or drift about in the sea and are known collectively as "plankton," require other methods of capture. The instrument almost universally used for this purpose is the tow-net, which is simply a cone-shaped bag made of Swiss silk or bolting cloth, the mouth of which is attached to a wooden ring. For taking very small animals (microplankton) the tow-nets are of exceedingly fine silk with a mouth diameter of eighteen inches, and a length of five



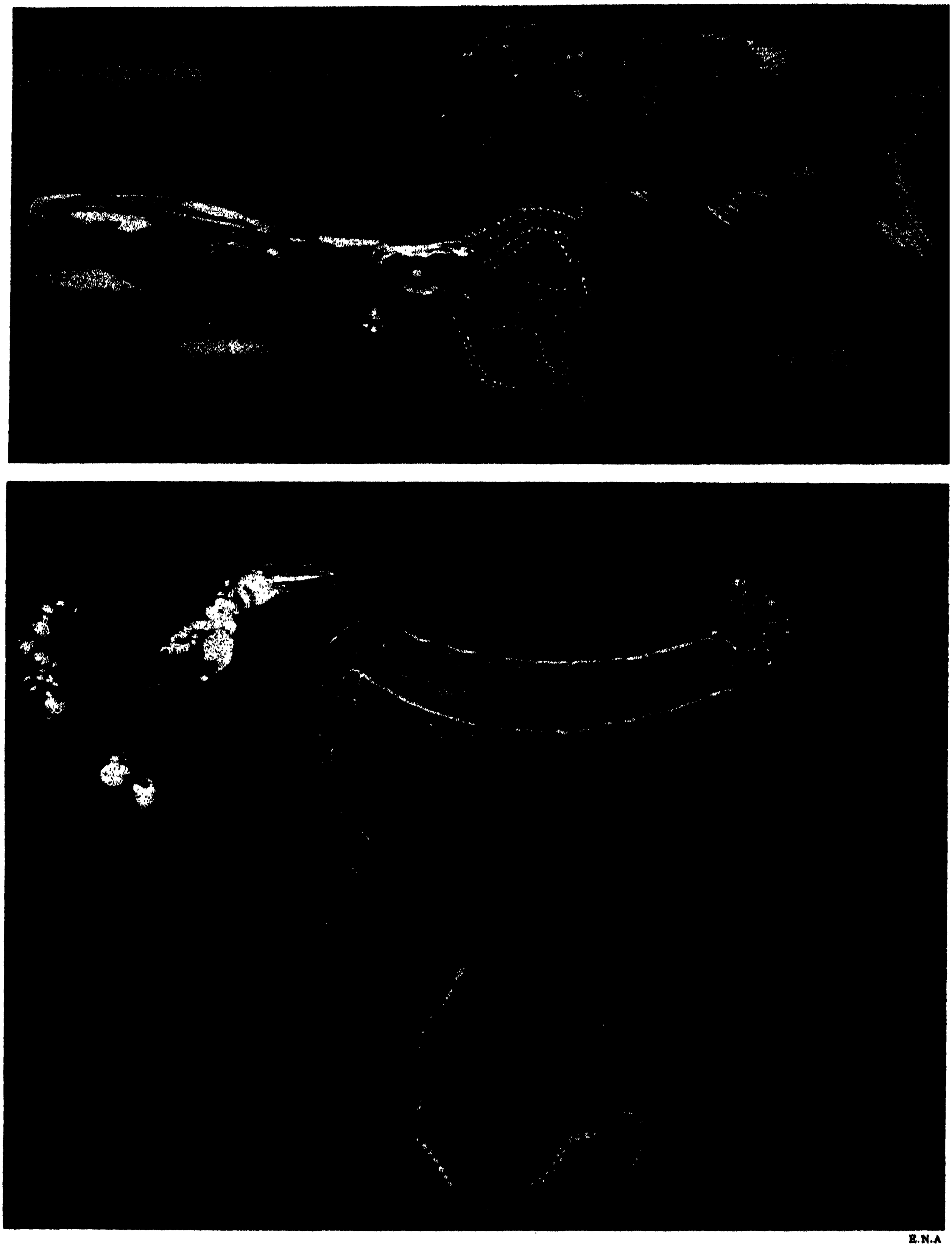
MULTITUDINOUS LIFE, VIVIDLY COLOURED, AND THE PHOTOGRAPHER AT THE BOTTOM OF THE TROPIC SEA

Life luxuriates in the sea to an extent unequalled on land. In this photograph, and the others of the Williamson Expedition, we have a case of inhabitants of the land looking out, by means of special apparatus, upon the unwonted realms below the sea. This observation post reveals a constant pageant of life, fish of all colours and sizes against a background of plant life more vivid and fantastic than anything on land. The lower photograph shows the organizer of the expedition looking up the tube from the bottom of the sea.



BIG SHARK CASTS ITS SINISTER SHADOW ON THE SUNLIT FLOOR OF THE SEA

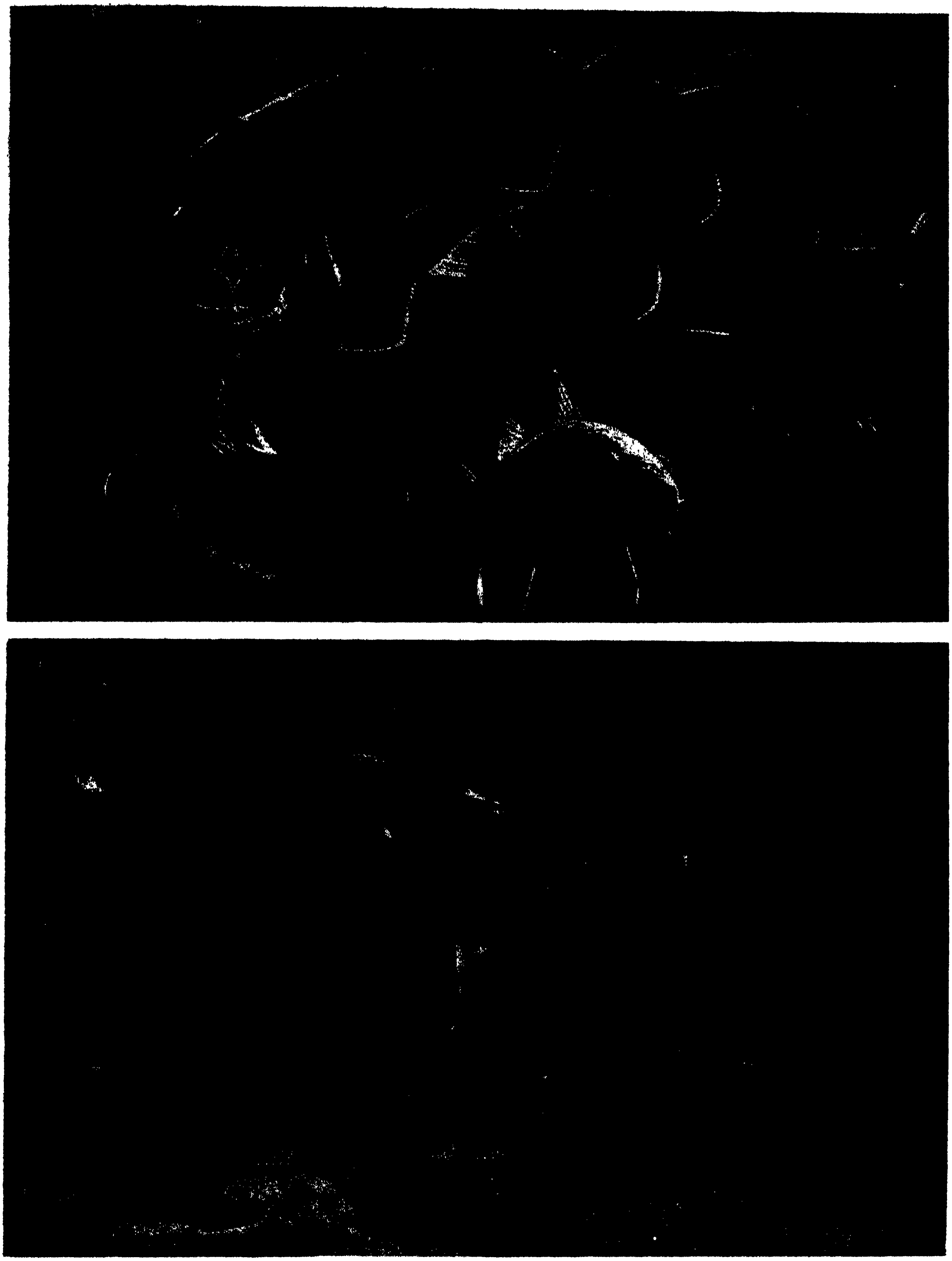
In the shallow waters about the coasts of the Bahamas the brilliant sunlight illumines the sea so brightly and the water is so clear that under-sea photography presents no difficulty as far as lighting is concerned. Notice that the big shark, gliding by upon his intent and hungry way, casts a strong shadow on the clear sand of the sea floor. Various other fish are moving about among the tussocks of weirdly formed weed which, tinted with the most varied colours, give ambush or sanctuary to pursuer or pursued.



E.N.A

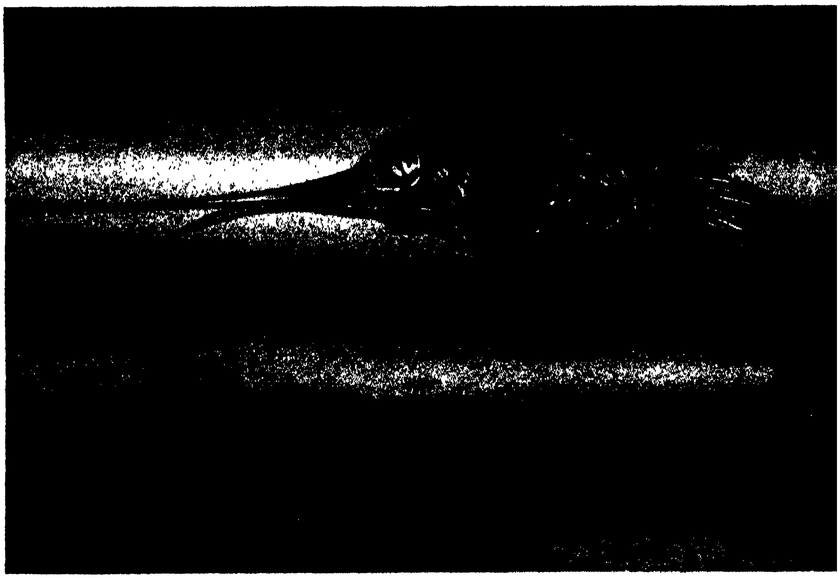
SOME STRANGE REPRESENTATIVES OF THE LIFE BENEATH THE SEA

By means of dredges, trawls and grabs, the fauna of the deep seas is raised from its obscurity and brought up to the surface for examination by scientists. These enterprising methods have yielded some strange finds. The lower photograph shows three strange beings fished up from the bottom of the Hudson Gorge. The animal with eyes on the ends of stalks is particularly remarkable. The upper photograph shows a fish with turquoise tinted scales and a squid which has some thousands of luminous spots on its body. Until about the middle nineteenth century it was believed that no life existed in the sea below the three hundred fathom line.



FISH FAMILIAR TO THE ANGLER AND THE BREAKFAST-TABLE : BASS AND COD

These photographs were taken in an aquarium, and it is from such places that much of our knowledge of life beneath the sea must come. Apparatus such as the exploring ship and its flexible tube, illustrated in previous pages of this chapter, is, naturally, not very common and, in any case, with it life can only be studied in conditions that are entirely natural, at depths shallow enough to admit of natural lighting. Bass (bottom) are related to the perch. Above are some cod from two to four years old. These photographs, and those in pages 989 and 992, are by F. Schensky of the Heligoland Biological Station and are given by permission of Dr. Werner Klinkhardt.



E.N.A.

WEIRD FISH FROM A MILE BELOW THE SURFACE

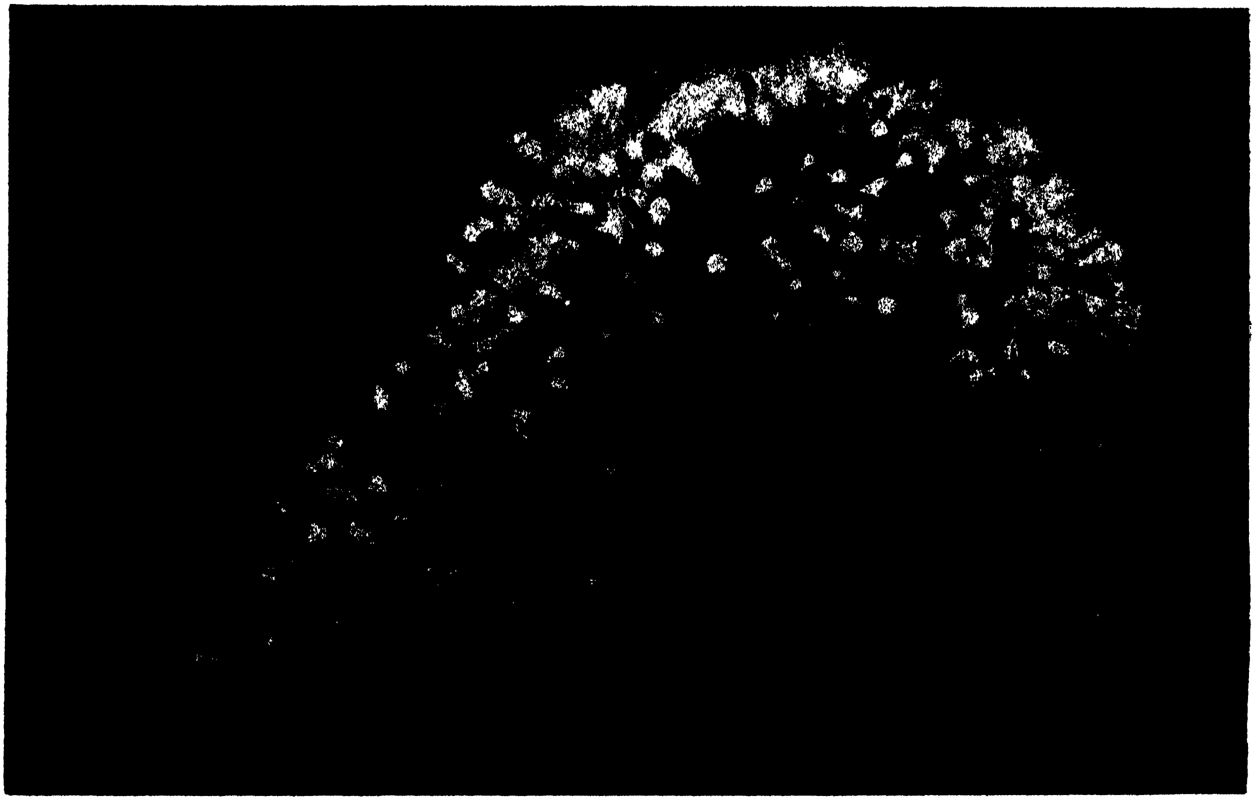
One of the most extraordinary things ever fished up from the depths is this so-called snipe-billed eel (bottom). Why it should have developed the extraordinarily bird-like protuberance on its head is a mystery, as is the way the two halves of the " beak " divide. Above we have an eel-like fish with a head like that of a snake in a nightmare. These teeth are really terrible.

feet. When the larger plankton animals (macroplankton) are required, the ring-net or ring-trawl is used. This has a mouth-opening six feet in diameter and is about eighteen feet long. In order to capture only the organisms living in any particular layer, say between 200–300 fathoms, a net has been constructed which can be let down closed, then opened, hauled vertically through the desired distance, closed again, and then hauled up. In this way, by lowering to different depths and comparing the catches, valuable information with regard to the vertical distribution of the plankton can be obtained.

But dredge and trawl, townet and grab, though they have enabled the marine biologist to build up a fairly accurate and consecutive knowledge of the nature and wealth of life in the sea, leave him almost totally ignorant of what may be termed the intimate daily life and habits of those ocean dwellers. Land animals have been closely studied in their native haunts by many observers, and the habits of most are fairly well known. But what goes on in two fathoms of water is to this day shrouded in mystery. The veil, however, is gradually being lifted by energetic and ingenious workers along new lines, particularly on the other side of the Atlantic.

In the last year or two this hitherto unseen world has been visited by man, observed, sketched, and even photographed in natural colours.

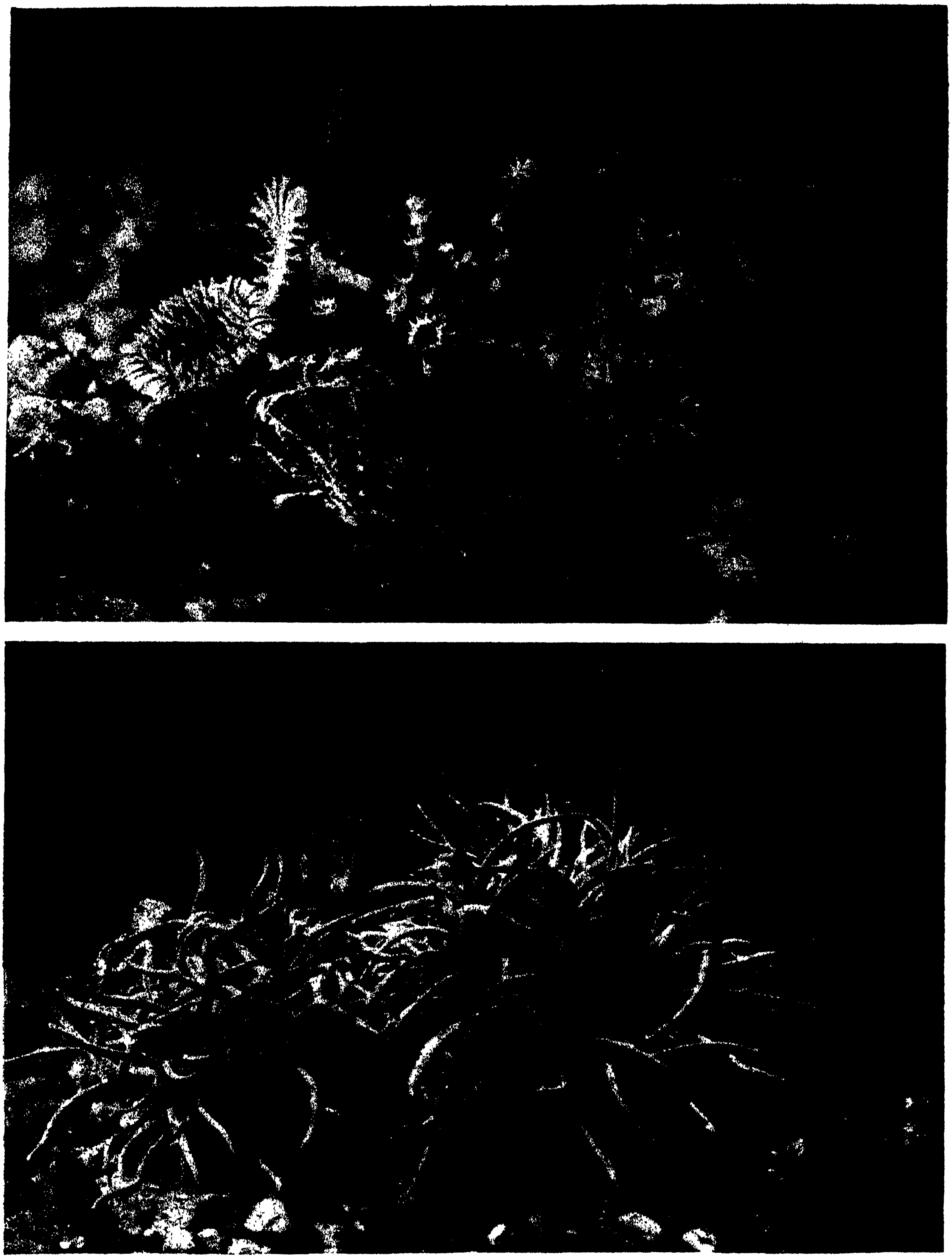
One of the pioneers of undersea exploration is Mr. William Beebe, leader of several recent oceanographical expeditions, and author of two delightful books on his experiences—" The Arcturus Adventure" and " Beneath Tropic Seas "—books which all interested in marine and submarine exploration along the most modern lines should read. In the former book is described a diving helmet which was used with much success for submarine observation among the Galapagos Islands. This instrument, which is made of copper, fits over the head and rests upon the shoulders. To its lower edge four flattened lead weights, each weighing ten pounds, are attached to help to keep it in place. A hose is connected to the right side through which air is pumped to the diver, and two obliquely-placed glass windows in front give a fairly large field of view. The use of the helmet is simplicity itself. Garbed in a bathing suit, the diver steps over the side of the parent boat and descends the first few rungs of the ladder. The helmet is then slipped gently over his head by one of the boat's crew, pumping begins, and down the diver goes. The air inside the helmet prevents the water rising above the chin, unless of course, the wearer bends forwards, when the level of the water rises, relative to his face.



Schensky

SEA POLYPS LIKE A PYROTECHNIC DISPLAY, AND A REMARKABLE PRAWN GROUP

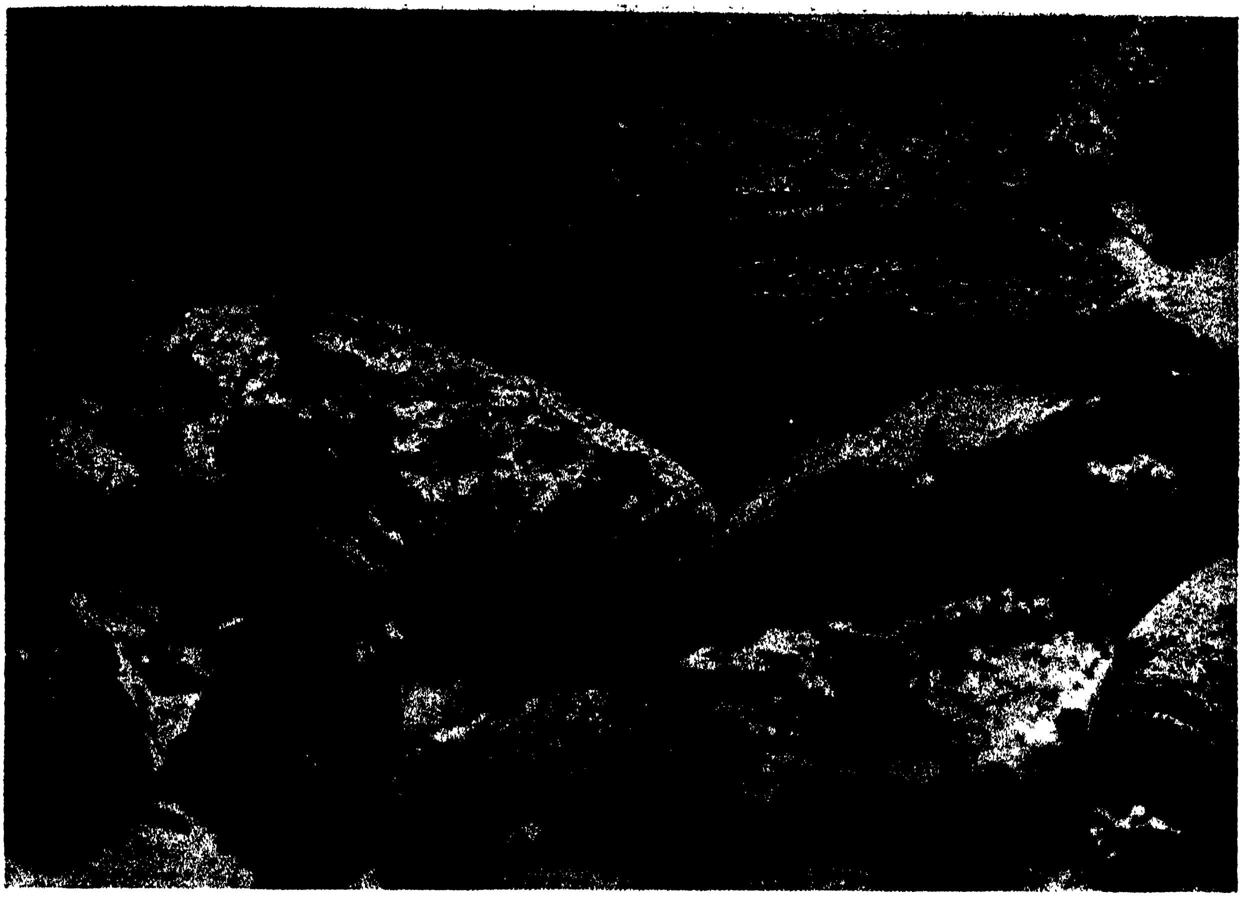
If one were to paint the momentary brilliance of a great burst of fireworks the result might well look, when photographed, like the lower illustration here, which shows some scyphistoma polyps, lovely creatures which grow beneath the salt sea. They are one of the two alternate generations of the disk jelly-fish. Sexual, egg-laying offspring alternate with asexual offspring (the form seen here) which produce jelly-fish by budding only. Above is a group of prawns. Some of these are in strange attitudes, as of supplication.



W. H. A. Fincham

FLOWER-LIKE FORMS OF OPELET AND DAISY ANEMONES

Underneath the surface of the sea there exist the most amazing forms of life, many of them reminding us of something on land and yet most of them with a touch of the bizarre—from the land point of view. But to study these forms of life, and especially the type seen here, it is necessary that the appropriate lighting should be in operation. A sea-anemone out of water is a sorry thing, but its true life can be watched through the glass panel of an aquarium. The lower group (opelet) is formed much like the tubular petals of some flowers.

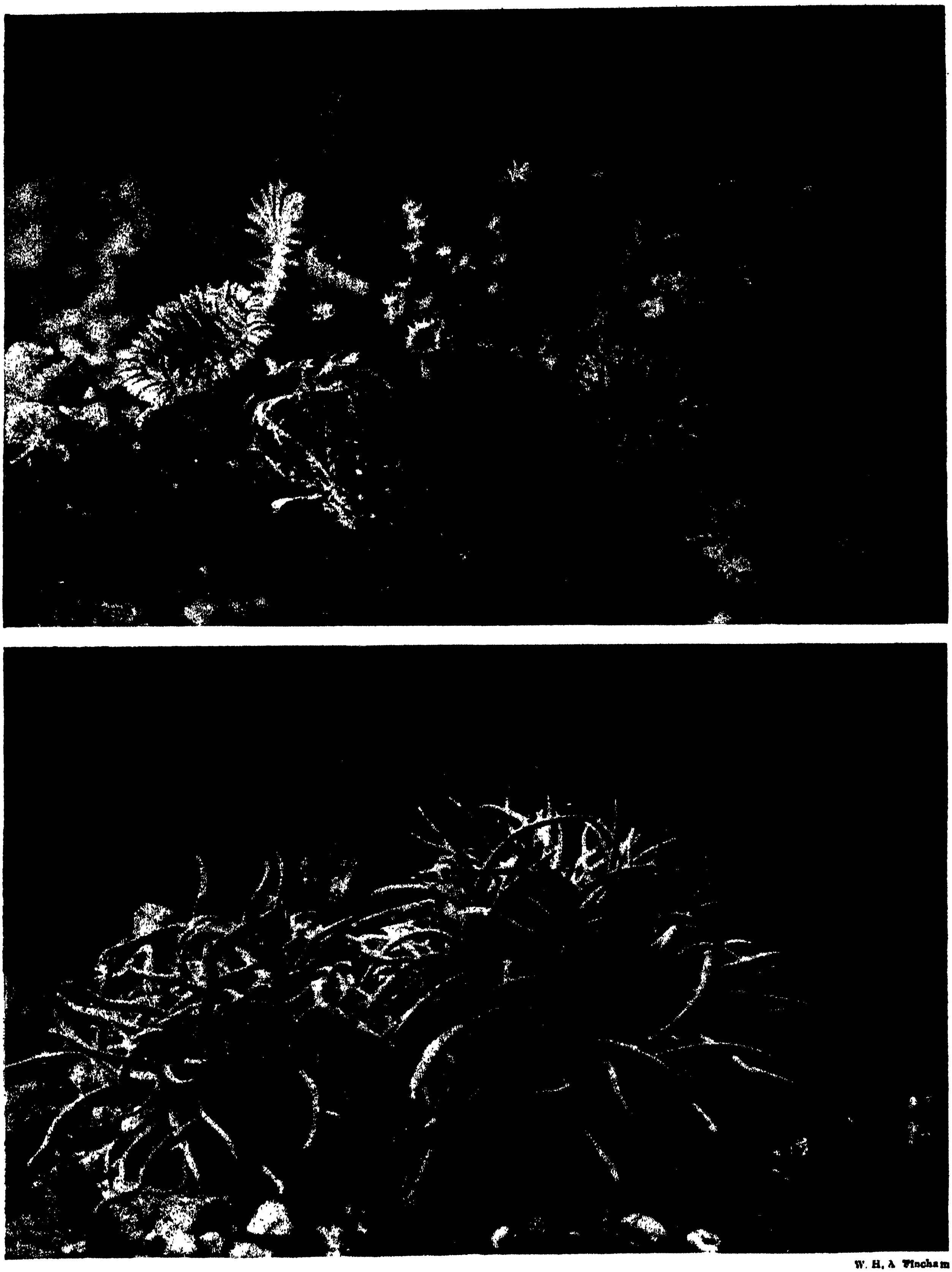


The great advantage of the diving helmet over an ordinary diving suit—which is quite useless for this type of work—lies in the fact that it encloses only the head leaving the rest of the body free and unencumbered. As an example of what new facts of great interest may be gleaned by its use, one may mention only two of Beebe's experiences. When on the sea bottom he found that, by swaying gently with the movement of the water, all the inhabitants round about "from gobies to groupers, from shrimps to sharks," accepted him as something properly belonging to their domain and approached without fear.

But if he resisted this backward and forward aqueous surge and remained stiffly still, he was at once avoided as an object of suspicion. Here, at the outset, is revealed behaviour entirely opposite to that on

PHOTOGRAPHS FROM DAVY JONES'S LOCKER: VIVID LIFE IN THE DEEPS

When sailors wished to refer to the abyss over which their ships sailed they talked of Davy Jones's Locker. But none of these old salts had ever been down below to study the wonderful contents of that locker. Thanks to modern invention we can sit in an armchair and gaze at some of the wonderful creatures that occupy these once unguessed fields down below.



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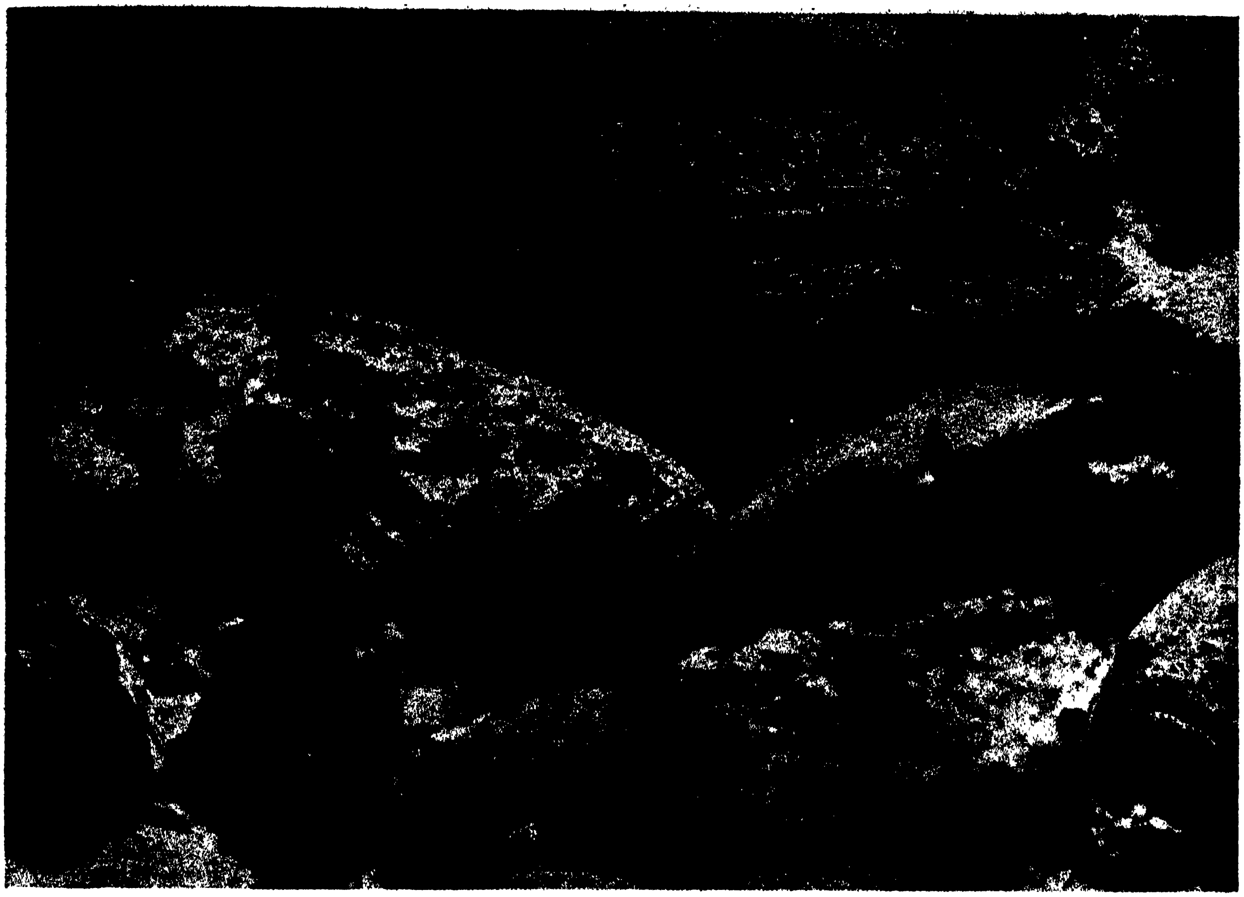

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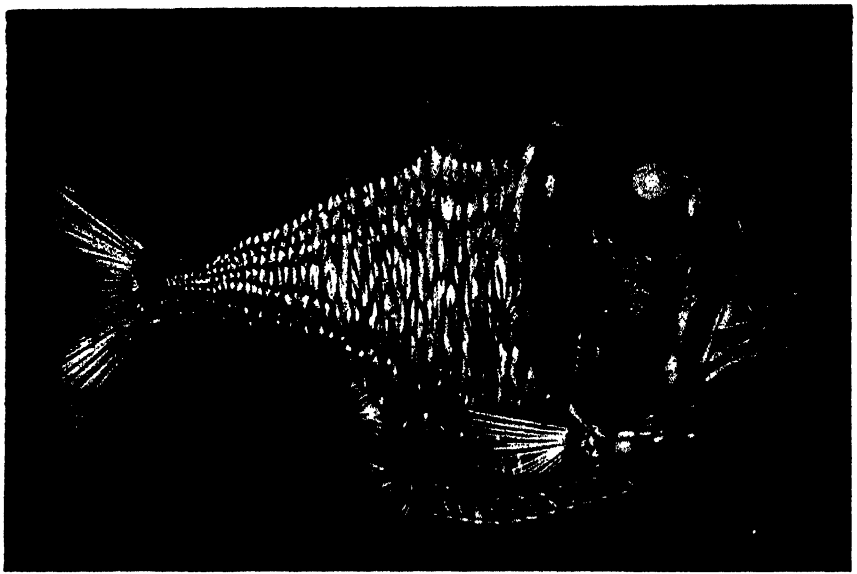


E.N.A.

land where the slightest movement startles wild life and only by absolute stillness can the observer attain his object of allaying fear

The invention and use of the diving helmet has brought in its train a still more interesting and useful development of submarine investigation. With its aid under-water photography is now being undertaken with conspicuous success. In 1927 Mr. Floyd Crossby returned from an expedition to Haiti with over 1,200 feet of film illustrative of life on a coral reef below the surface of the sea. In January of the same year there were published in the National Geographical Magazine, Washington, D.C., eight natural colour photographs of marine life in its natural habitat—the first natural colour photographs that have ever been made beneath the sea Dr. W. H. Longley, a noted American ichthyologist, developed the technique by which this feat was achieved at a depth of two and a half fathoms.

A unique and very ingenious method of direct submarine observation, however, is that which was adopted by a Mr. J E. Williamson, who, with his bride, returned to New York City after spending the larger part of a seven and a half months' honeymoon under the waters surrounding the Bahama Islands.

They studied aquatic life beneath the surface from a specially built compartment attached to a long flexible metal tube with a boat as a base. The tube was invented by Capt. Charles Williamson, father of the photographer, for use in salvage operations, and it was while young Williamson was watching his father use it thus that he became inspired with the idea of adapting it for submarine photography. The tube is built of flexible sections firmly bolted together. To the bottom section is attached the more or less spherical observation chamber, slightly over five feet in diameter and provided with plate-glass windows. By adding sections at the top of the tube the chamber can be sunk to any desired depth. The diameter of the tube is two feet—large enough to allow a man to slip down through it into the observation chamber below. Here two or three people can be comfortably accommodated. Hundreds of under-sea photographs and thousands of feet of motion pictures have already been taken from this ingenious tube. In addition, many water-colour sketches, the first ever painted beneath the sea —sketches of living corals and the multi-coloured reef fishes which dart in and out among enchanted coral groves—have been executed.

Thus are the mysteries of the deep being explored.

Schensky

JELLY FISH AND HATCHET FISH

Below we see comb jelly fish or ctenophores, whose "bodies" may be more than 99 per cent. water, and above a hatchet fish from the deep seas. The curious shape of the last with its slim tail and enormous and suddenly swelling stomach is very remarkable.

Chapter XC

Some Mysteries of Animal Life

By E. G. Boulenger

Director of the Zoological Society's Aquarium

EVERY phenomenon of Nature is a mystery until elucidated. Thanks to painstaking investigators elucidation moves apace, and it is now generally recognized that few of the apparent enigmas are incapable of natural explanation. There is, however, still a wealth of unanswered riddles to excite the curiosity. Why, for instance, should certain animals be burdened with cumbrous appendages of no apparent use and presenting features that appear to be borrowed from others claiming no relationship? In this chapter we offer some explanation of a few of these enigmas, reminding the reader beforehand that such explanations are as yet put forward merely as plausible theories.

Quite a number of animals go through life loaded with adornments that cannot fail to cause them considerable inconvenience. Can fashion alone be the explanation? It is one not so absurd or illogical as it may at first appear if we consider man's self-inflicted agonies in the same cause. Animals, being less masters of their fate than man, persist in adornments that cannot be thrown aside at will. Certain chameleons, for instance, wear huge structures of skin and bone which protrude from the forehead like bowsprits and may exceed the bulk of the entire head; whilst the giant fish-eating crocodile, or gharial, has a box-like structure surmounting its snout which can be of no utilitarian value and may possibly prove an actual hindrance. The heads of the horned lizards of North and Central America are surmounted with enormous spines which in some cases exceed the creature's head in length. No use is made of these formidable-looking weapons for either offensive or defensive purposes, the reptile when molested relying on frustrating its enemy by shooting a fine jet of blood at its aggressor from the corner of the eyes.

F. W. Bond

MAHOLI GALAGO AND YOUNG

South Africa is the home of the maholi galago, an animal about the size of a rat and possessing extraordinarily beautiful eyes. It ventures out only at night and has a curious habit, mentioned in this chapter, when preparing itself for climbing trees

The use of the rattlesnake's rattle has been freely discussed. The utility of the apparatus to the creature is very problematic, for whilst it may serve as a warning to approaching enemies, it on the other hand draws the attention of hostile creatures to its presence. It has been suggested that the rattling sounds serve to call the sexes together; also that, resembling running water, they act as a decoy, attracting the serpent's prey. In this connexion it is worth bearing in mind that other poisonous snakes not provided with a rattle have the same habit of vibrating the end of the tail when excited or alarmed, and thus when reposing amongst dry leaves and twigs produce sounds very similar to those of the rattlesnake.

In the animal world certain apparently useless adornments are confined to the male. The bull hooded seal wears upon its crown a monstrous crest of fat extending from snout to occiput and reaching a height of six inches. The saiga antelope has its nose developed into a large puffy mound suggestive of disease or at the best a severe wasp sting. It is suggested that this organ may be a special provision to prevent sand entering the nasal chamber, but the saiga is sufficiently rare to preclude verification of this ingenious suggestion.

Nature is continually producing hypertrophies which sooner or later become a hindrance. The giant reptiles of the past developed such a wealth of armature that the wearer was

frequently too encumbered to make effective use of the very horns and shields developed for its protection. The massive Triceratops evolved a head that eventually occupied one-third of its entire length and it must have been far too cumbrous to permit of rapid enough movement when confronted by an equally enormous but lightly armed lizard which could leap like a kangaroo, and was furnished with a set of teeth averaging three inches in length. The famous sabre-toothed tiger, contemporary with early man, produced a pair of upper incisors projecting beyond the mouth. The great length of these tusks prevented their being used in the normal manner as they barred the mouth even when the latter was open to its full extent. As its brain apparently failed to move with the times its demise synchronised with the sudden rapid improvement of pick-axe, spear and arrow-head.

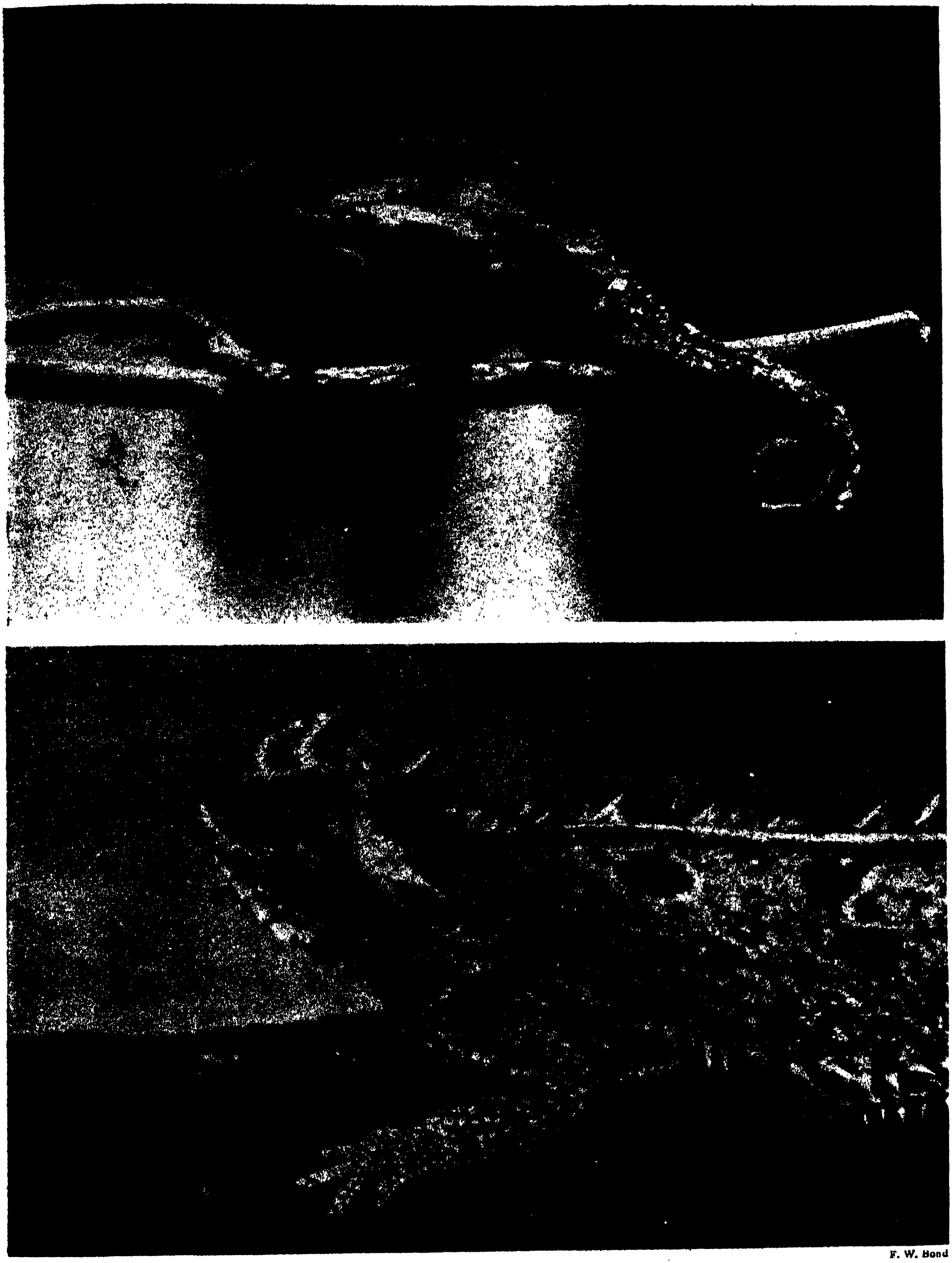
A WEAPON of any description is only effective when easily operated; size and weight are in themselves no assurance of victory—the knight disappeared with the advent of the cannon, whilst the big battleship and the tank only live on sufferance from the aircraft with its high explosive, incendiary and gas bombs. In the wild the stag's picturesque horns that look so invincible when carried by some haughty buck in his prime frequently prove their possessor's worst foe. The antlers often become interlocked during the duels of the rutting months, and many collections have been formed of horns that have become so inextricably jammed that in every case the duel has concluded by death from starvation on the part of both combatants. Antlers frequently become entangled with tree branches, placing the stag at the mercy of the hunter—whether beast or man. In one recently reported instance a "twenty-pointer" met its death whilst in the simple act of driving away flies. One foreleg became so involved with the profusely branching horns that the deer in its efforts to free the limb broke its own neck. Stranger still is the case of two mountain rams who, chancing to duel beside a young oak, drove their horns into the trunk and so remained captives until fortunately they were discovered by a ranger.

The reptile world offers one very striking instance of over-developed armature. This is

F. W. Bond

CHAMELEONS WITH USELESS WEAPONS

Certain chameleons have huge horn-like projections on their heads which might be taken for weapons of defence. But they serve no such useful end, and their purpose is a mystery. Below is a rhinoceros chameleon and above a specimen of Vosseler's chameleon.

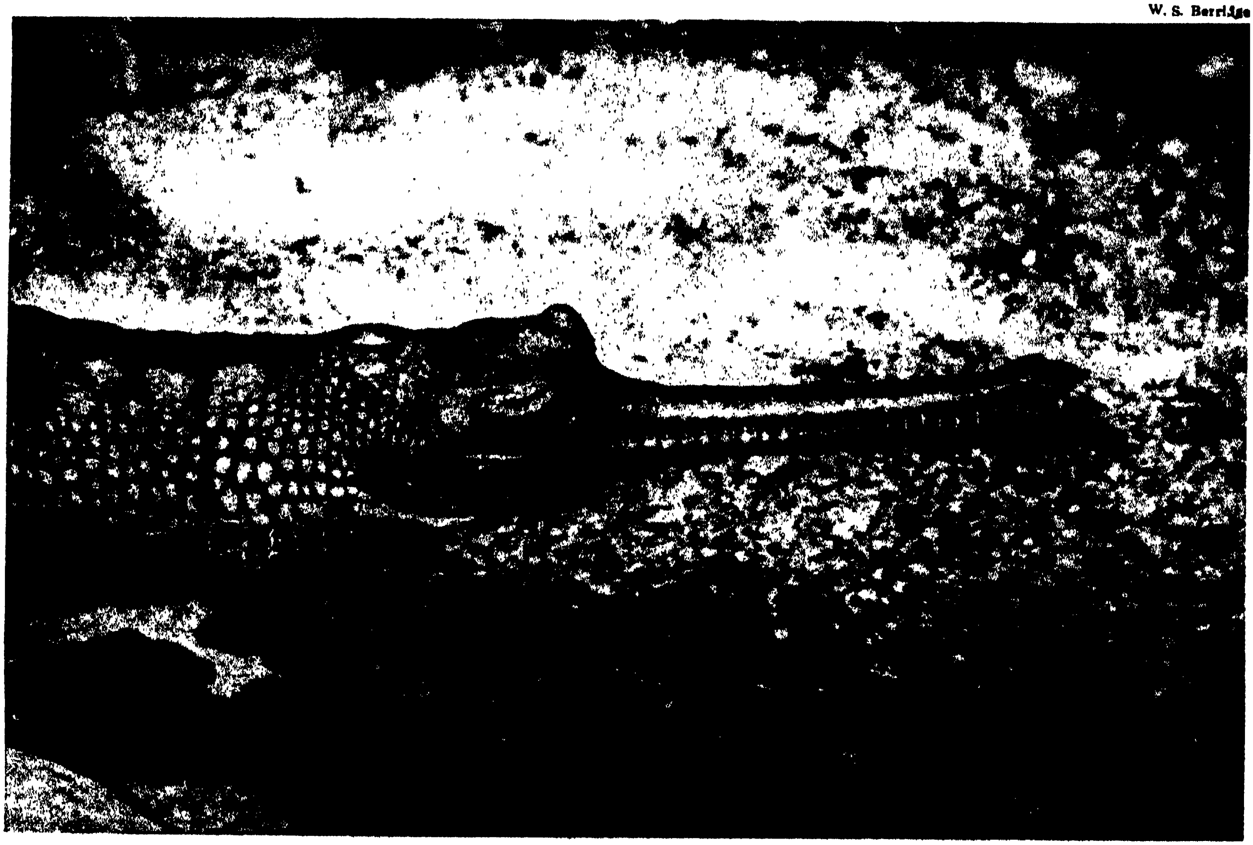


F. W. Bond

FORMIDABLE LOOKING HEAD OF THE HORNED LIZARD: WERNER'S CHAMELEON

It is one of the little puzzles of which Nature is so full that an animal equipped, like the horned lizard (bottom), with a number of spikes on its head should make no use of them whatever for defending itself. On the contrary, this creature adopts quite a different method. It squirts blood from its eyeballs, a manoeuvre sufficiently horrifying to daunt the most bold attacker. Werner's chameleon (top) is also armed with spikes but depends entirely on making itself inconspicuous for its safety.

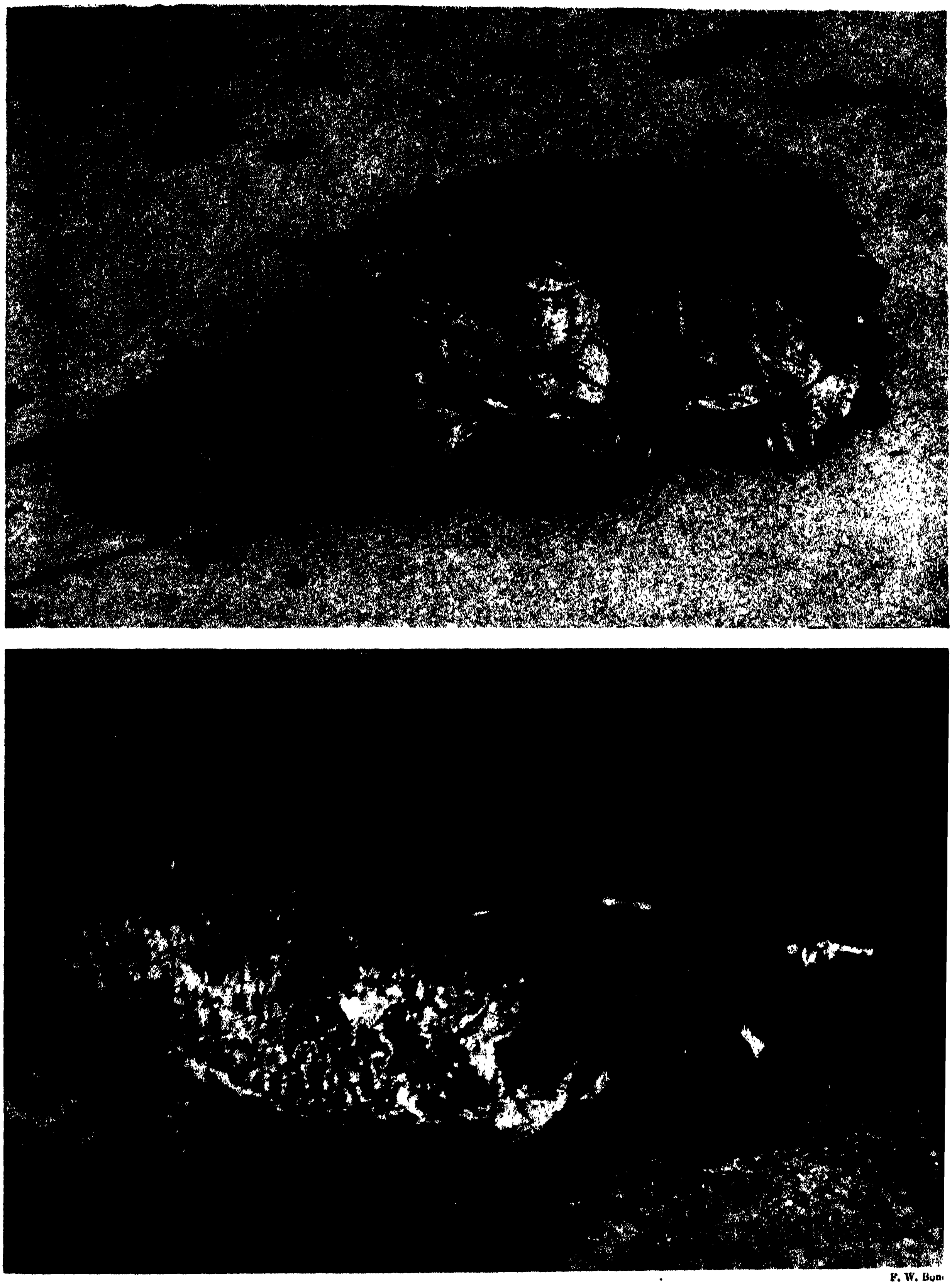
W. S. Berridge



F. W. Bond

THE GAVIAL AND THE UNACCOUNTABLE DEVELOPMENT OF ITS HEAD

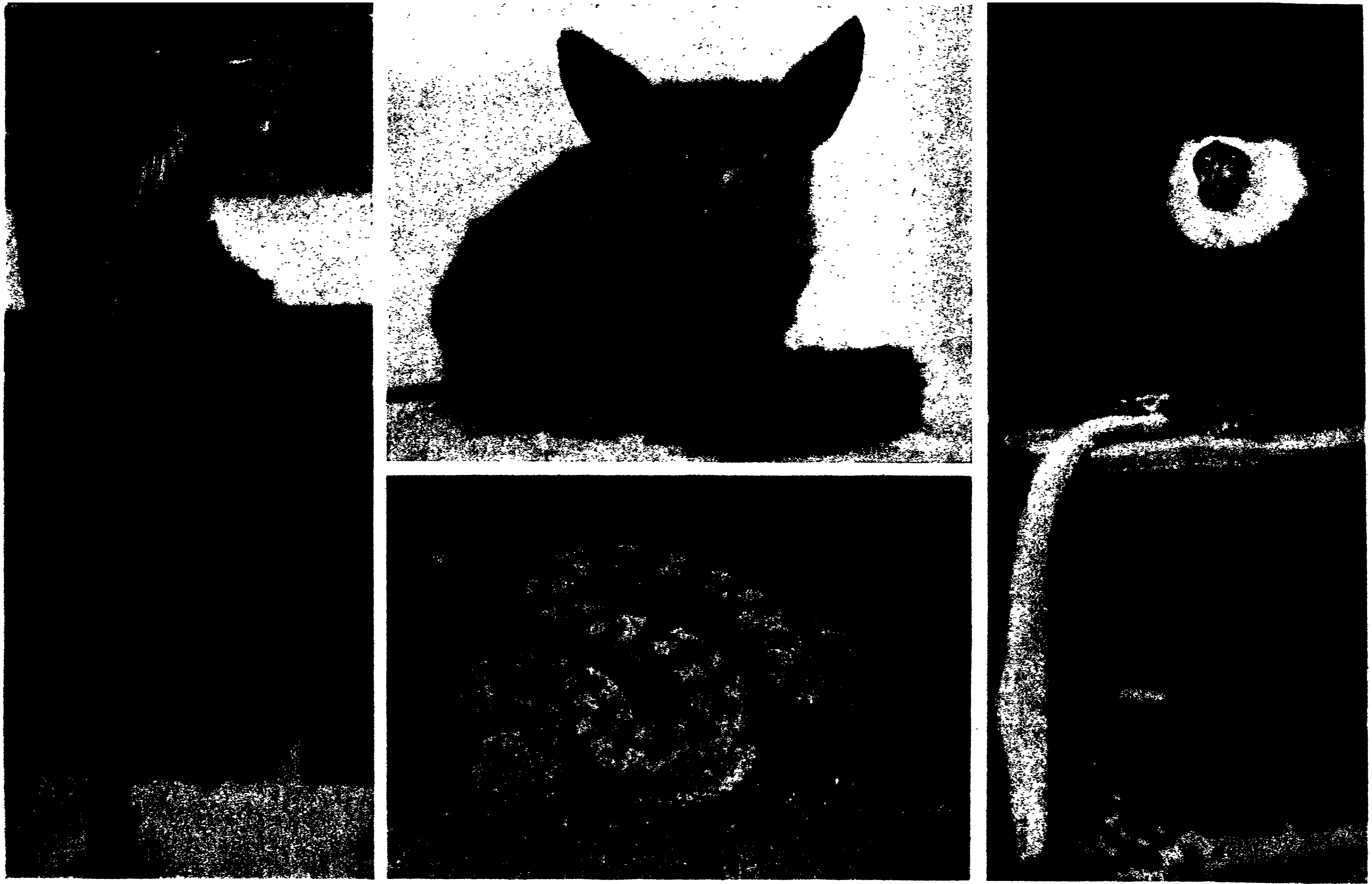
Why the gavial, the great fish-eating crocodile of India's rivers, should, apparently, minimise the utility of its mouth by having a box-like structure on its snout is more than anyone can say. This is an extremely old animal, remains of it having been found in deposits of the Tertiary period. Possibly some former need, brought about by conditions now long vanished, induced the development of this—so far as we can see—useless appendage. The detail of the head can be studied from the lower photographs while above we get a view of the whole animal.



F. W. Bond

MATAMATA TORTOISE OF BRAZIL AND ITS STRANGELY-FORMED NECK

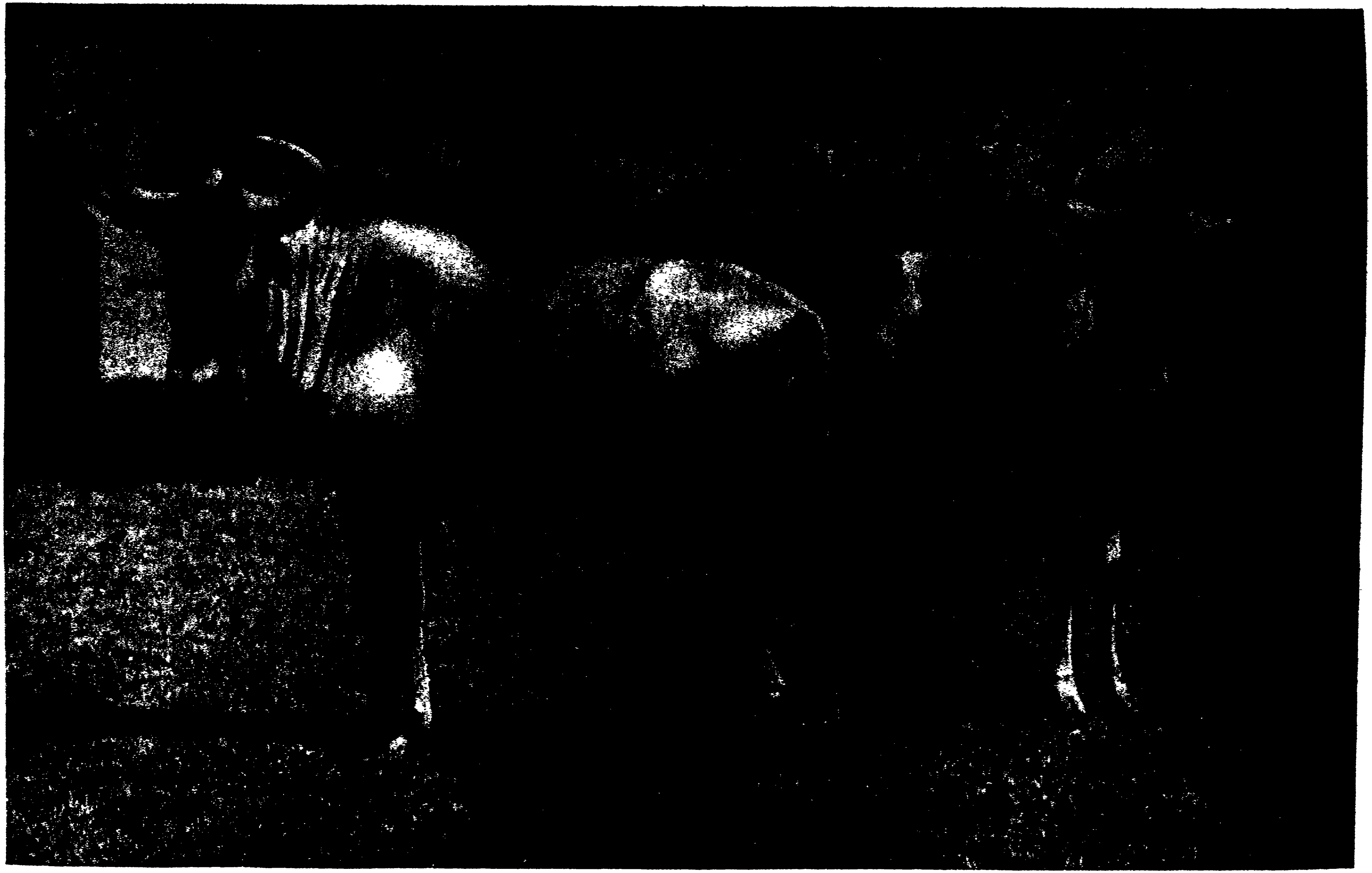
This weird-looking tortoise which lives in northern Brazil and in the Guianas has its shell corrugated in the most extraordinary way so that it looks like an aerial view of a knot of mountains. The neck is broad and elongated and bears a kind of fringe of fleshy projections whose use, if there is any definite use for them, is not clearly understood. They may serve either to disguise the owner from its food—tadpoles and fish—or from its enemies. As seen by itself (bottom) it is hard to guess that this object is an animal's head and neck.



W. S. Berridge

ANIMALS PROVIDED WITH EQUIPMENT WHOSE REASON IS A PUZZLE TO NATURALISTS

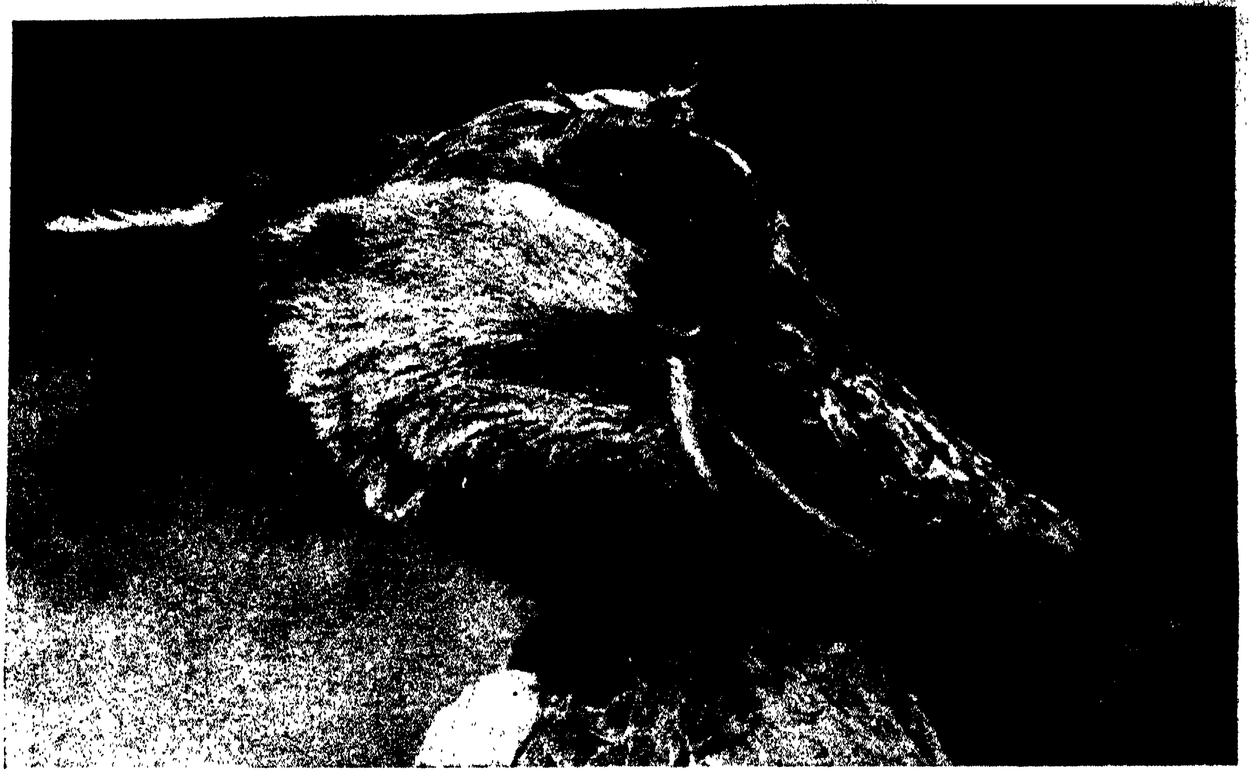
Found in many parts of Central Africa, the guereza monkeys are remarkable in the development of their hair. Ruppel's guereza (left) also called the Abyssinian guereza, looks as though it had assumed a coat of goat-skin, the long locks hanging down like a garment. On the right we have the white-tailed guereza or colobus. We do not know the reason for these exaggerated coats of hair, especially as their wearers live in an intensely hot climate. The Cerastes (centre, bottom) is a viper possessing a horn above each eye. These horns are scaly and occur always in the males and sometimes in the females. Their purpose is still a matter for conjecture. The galago (top centre) is a nocturnal tree climber of mysterious behaviour.



Autotype

PAIR OF GNUS, ANIMALS WHICH STRANGELY COMBINE FEATURES OF ANTELOPE, HORSE AND OX

When we first see a gnu we are reminded of three animals at once, the antelope, horse and ox, so strongly that the gnu seems to be a kind of joke on Nature's part, rather than a piece of serious creation. The horns are strangely curved, though in early life the gnu's horns are straight and grow from the skull at some distance below its highest point. These weapons of youth are pushed outwards by succeeding growth so as to form the tips of the adult armament. The bases of the horns gradually grow towards each other until, in old bulls there is a kind of horn helmet as in the case of the Cape buffalo. It is still not quite certain to what animal the gnu is most nearly related, so puzzling is this inhabitant of the veldt.



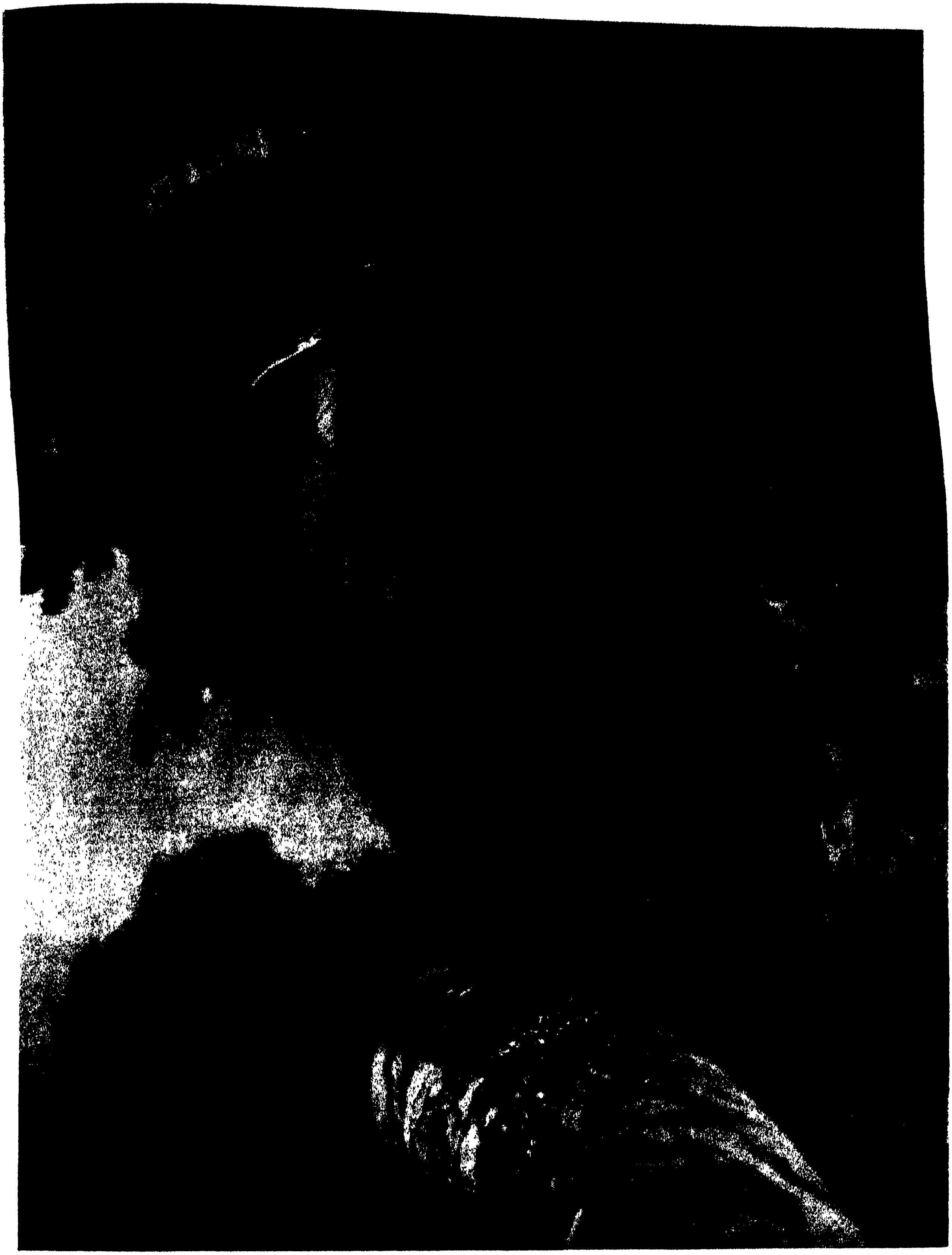
F. W. Bond

STRANGE BEAK FOR CATCHING FISH

The Arabs call the whale-headed stork "father of a shoe," which is reminiscent of the alternative English name of shoe-bill. Seen in profile, the beak is concave (top) and a ridge runs the length of the upper mandible, ending in a strong hook. The bird is a fish eater, but this does not fully explain its strange beak development.

seen in the Atractaspis viper, a small snake with such disproportionate fangs that it is unable to use the two in unison. The fangs exceed the head in length and when "out for blood" the snake extends only one at a time at an obtuse angle to the roof of the mouth. The ringhals cobra of South Africa is a true enigma, since it spits poison, spraying the deadly fluid from its fangs to a distance of many yards. Why should it do this when few creatures care to challenge it, and when, as in the case of other non-spitting cobras, a single bite guarantees a meal or entirely discourages the aggressor?

The behaviour of animals is sometimes very hard to explain. Why does a dog often revolve, restlessly scratching, before composing itself to rest? One explanation is that the action is inherited from wild animals who were compelled to behave thus whenever scratching out a rest hole for themselves in dry earth, dead leaves or long grass. The suggestion is plausible and if correct proves how strong the hereditary instinct must be. The average pekingese, a breed intensively cultured for thousands of years, still shows the wild instinct when composing itself upon a scented cushion in a padded sleeping box or on an eiderdown quilt.

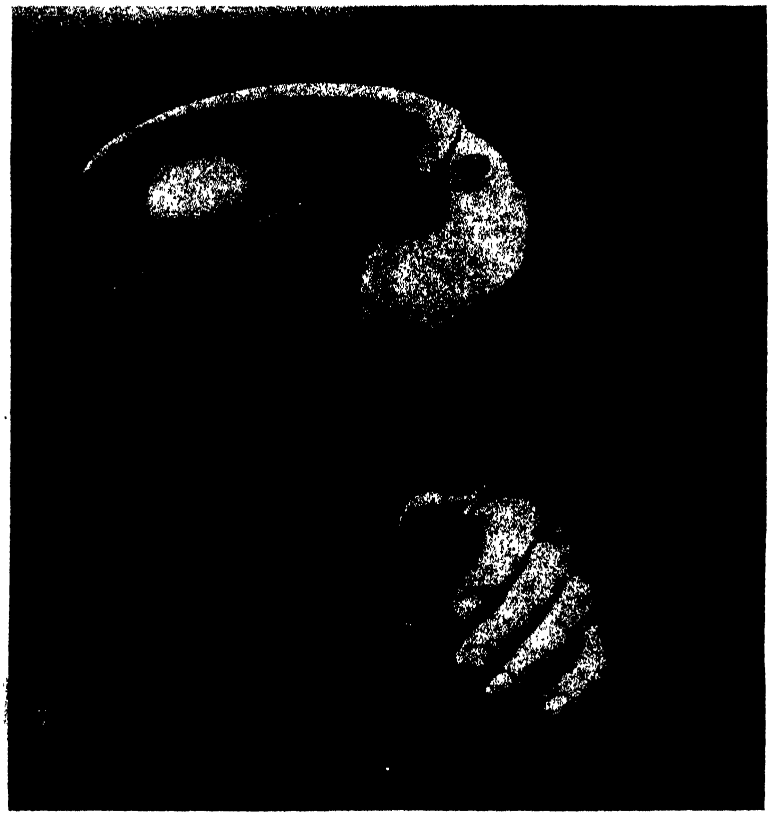


ONE OF NATURE'S MYSTERIES: THE GROTESQUE BEAK OF THE HORNBILL

This strange-looking bird is a black hornbill and comes from West Africa. The beak is enlarged by a hollow superstructure whose purpose is a mystery. It makes the beak into a formidable hammer, but the bird is not known to use it for any heavy work, such as the woodpecker does on tree trunks. The nesting hole in the trunk of a tree is found, not made, and the food consists of fruits and insects, the latter taken on the wing.

A real enigma is presented by the dainty little arboreal half-monkeys known as galagoes. The galago only ventures forth to feed on insects, fruits and birds' eggs after dark. Before climbing trees it always very deliberately covers the palms and soles of its delicately formed extremities with urine. As soon as the moisture has dried off the galago renews it before entrusting himself again to the topmost twigs and dangling creepers that form his home. The tree-tops in the tropics of both hemispheres swarm with arboreal animals—cat bears, spider monkeys, ant-eaters, and so on, yet in none of these is this curious habit developed.

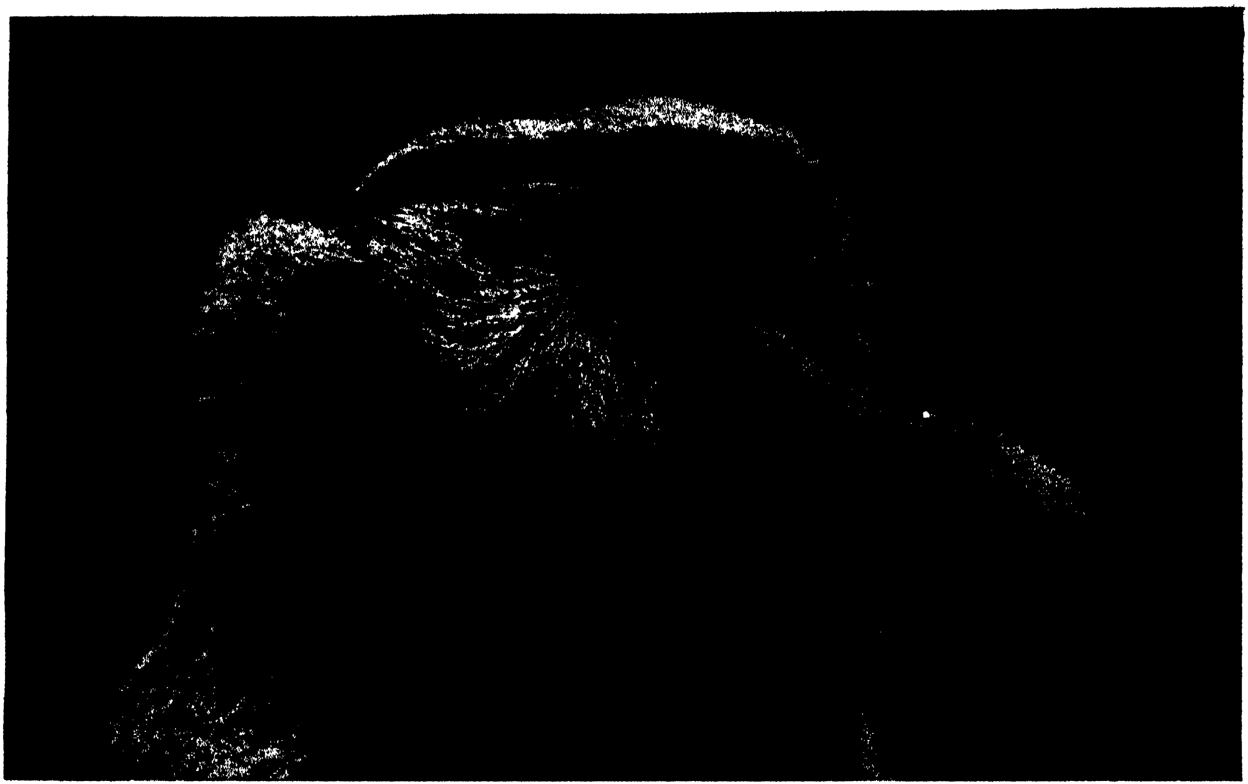
To return to the features of structure which still remain unexplained. The gnu, a large, horsey-looking antelope of the African plains, presents at first sight a jumble of a number of normal animals. The gnu's legs and feet closely resemble those of antelopes; its tail is densely haired as a horse's; its muzzle is as broad and splayed as that of an ox; whilst its horns are like those of no other animal past or present. Much more remains to be known of the animal's general economy before attempting to explain the reasons for this extraordinary specialisation. The plain-dwelling rodent known as the



F W. Bond

BEAK OUT OF PROPORTION TO HEAD

Compared with the rest of the bird the beak of the toucan is enormous and even disproportionate. Why it should need so huge a pair of mandibles is a mystery at present beyond our solving. Below is a red-billed toucan holding an egg in its beak while it perches on the keeper's arm and above is a specimen of Cuvier's toucan.

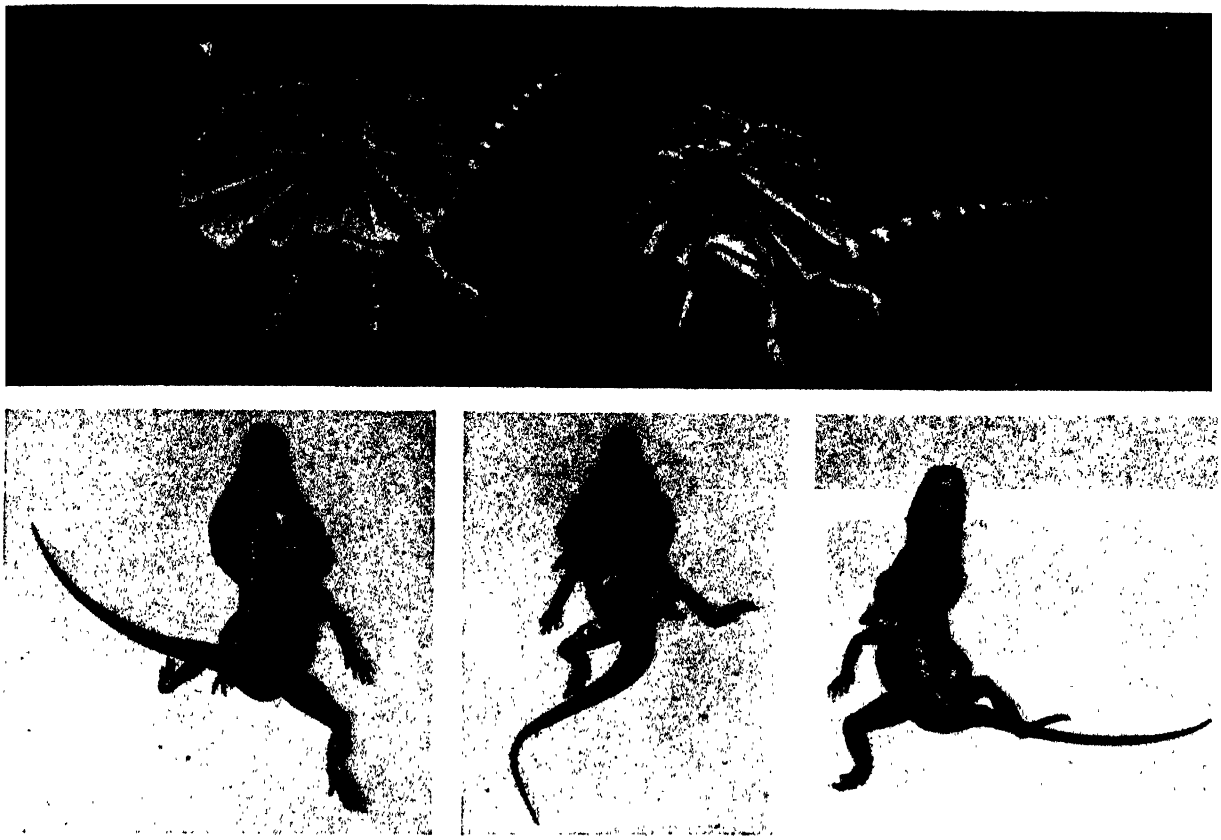


Autotype

F. W. Bond

DEPARTURES FROM THE NORMAL THAT EXCITE OUR WONDER

Why does the sloth hang upside-down ? The reasons for this inverted position are not easy to guess, since there seem to be no special advantages obtainable by hanging from a branch rather than lying along it. A life lived always topsy-turvy makes for indifferent progress along the ground, the sloths being all bad movers except in the trees. The upper photograph shows a proboscis monkey. What the purpose of the amazing nose may be and how it came to be grown are inexplicable problems.

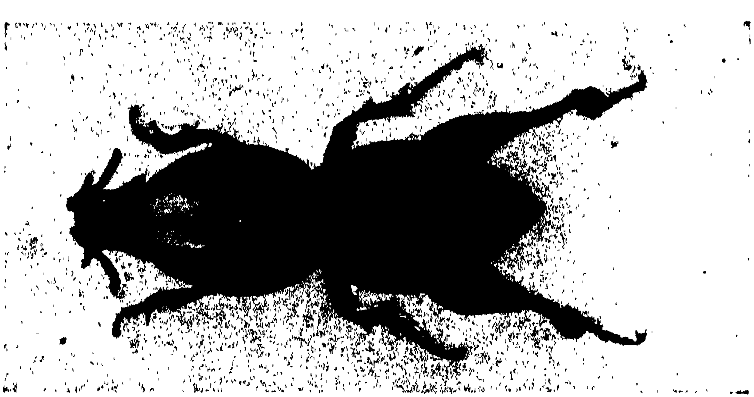


W. Saville Kent

AUSTRALIAN LIZARD THAT CAN BE A QUADRUPED OR A BIPED AT WILL.

There is a strange lizard inhabiting Queensland that has developed, round its neck, a frill which it can expand like an umbrella. But more extraordinary than this is its ability to walk either on all fours or on its hind legs only. Its gait, when in the upright, or bi-pedal, position is very strange to watch (lower photographs). In all these the frill is down, while above we see it fully expanded. This is about the most remarkable of the Australian lizards, and it is uncertain whether it will tend to discard one gait for the other, and, if so, which.

uscaisha, of South America, is at first sight merely a super guinea-pig. Whilst conforming to type in general make-up it presents two features which have puzzled the most expert. Its immense upper incisors protrude not from beneath the lip but through a sort of key-hole opening in the middle of the lip itself. Further, the middle and inside toes of the hind feet are surmounted by large knobs of fat covered with thick skin, from which there sprouts a series of bristles so hard and inflexible as to amount to spines. These, it is suggested, serve to cleanse the fur of sand and grit; the key-hole lip, however, reminds us that much yet remains to be explained.



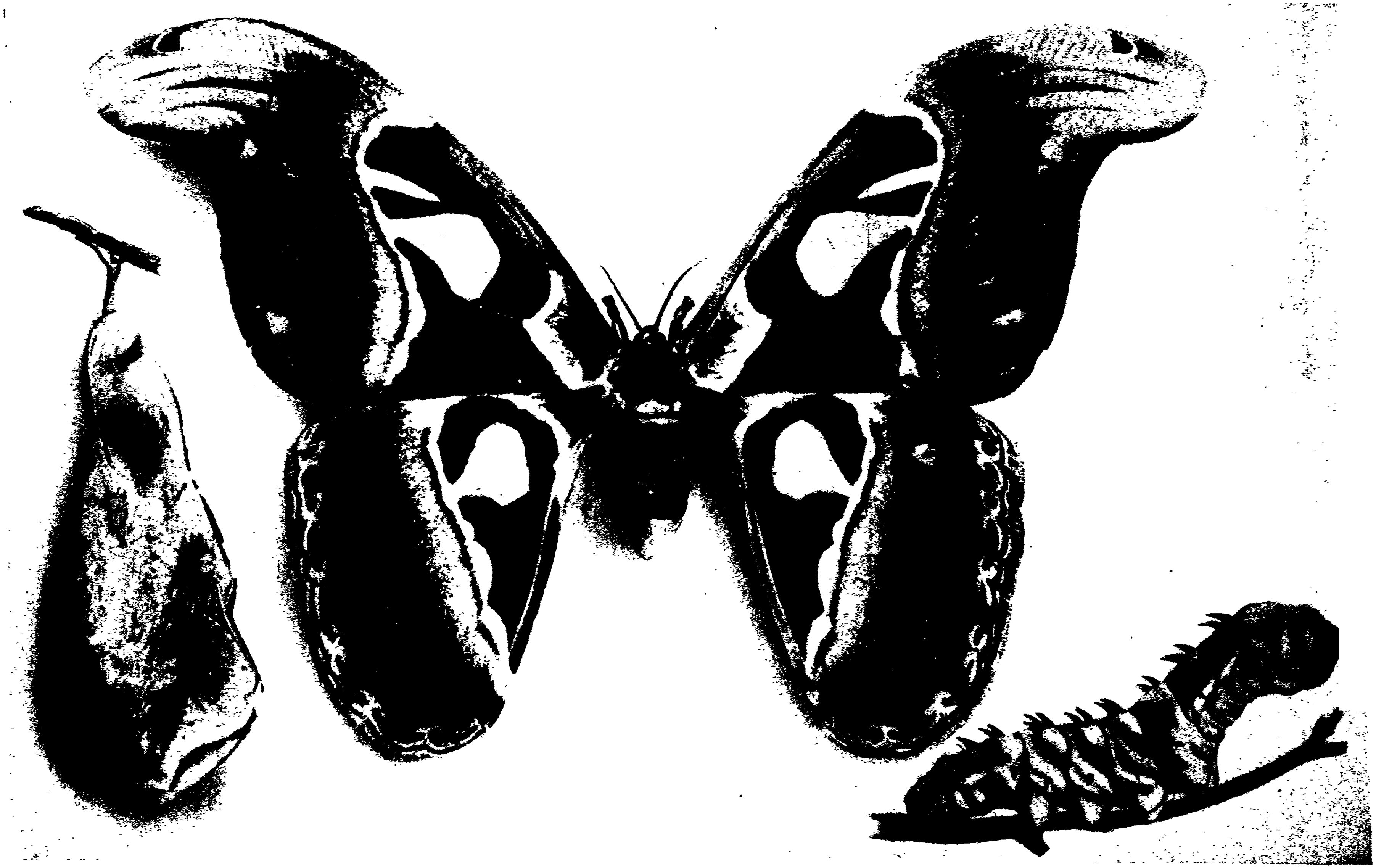
H Bastin

A PUZZLE FOR THE NATURALISTS

This extraordinary-looking insect, whose name is hipocephalus, has long been a matter for debate and perplexity among the naturalists. It is related to the mole cricket, but the exact relationship has never been successfully determined. It is interesting to compare this specimen with the mole cricket seen in page 913.

Hair and such similar developments of the cuticle as scales present the scientist with some of the guerezas haunting the hottest parts of Nyassaland and Abyssinia go through life beneath a load of hair that might guarantee a musk ox or polar bear against catching a chill. Of what service can hair, or at best a development of the flesh or scales, which almost amounts to hair be to a frog or fish? At least one frog bears at its sides a heavy fringe of stout bristles, whilst the male of a South American cat fish has the head similarly adorned.

These mysteries will no doubt be solved. It is a question of time and very patient study.



J. H. Watson

COCOON, ADULT LARVA, AND SPLENDIDLY-WINGED FEMALE OF THE ATLAS MOTH

The atlas moth of India, China, and Java is a giant indeed, with wings often a foot long and broad in proportion. It is a fine-looking insect, of a tawny colour and having a large triangular and transparent spot on each wing. The big cocoon spun by the larva is very valuable, since the atlas is a species of silk moth. This larva is a pale grey-green colour and is furnished on the back and sides with a number of spike-like projections. It consumes an enormous quantity of food, for the atlas moth into which it grows takes the place, among moths, that the hippopotamus and the elephant do among mammals, so far as size is concerned. This is brought about by a super-abundance of food and a more or less sedentary life.

Chapter XCI

Giants of the Insect World

By F. Martin Duncan

Librarian to the London Zoological Society

THE phrase "giant insects" may seem to be rather a contradiction in terms, for insects (Pliny's "little vermine") are, for the most part, such diminutive creatures that, in spite of the vast numbers that surround us on every side, in the air, on and in the earth, amongst the foliage, and beneath the water, and the important part they play in the economy of the world, we are hardly even aware of their existence—save when in mass formation they contrive to make their presence known and felt, or individually assert themselves in ways that are mostly unpleasant. Unless they force themselves upon our notice by biting, stinging, destroying our crops or our property, we are usually content to ignore them; and to most people, I am afraid, "an insect" simply means an obnoxious little pest to be crushed on sight.

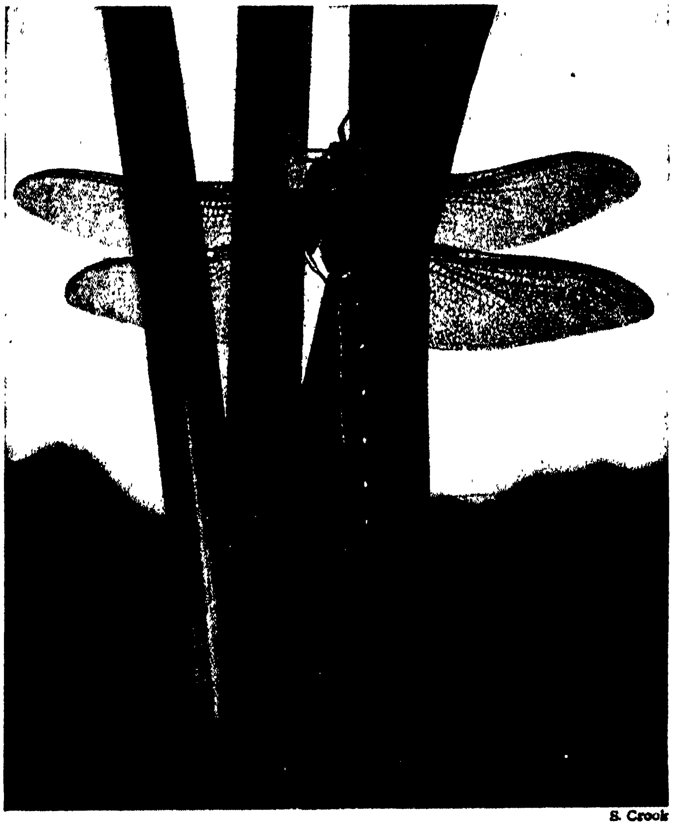
Yet the insect world, that is so inextricably bound up with our own, is full of interest and beauty. There is an infinite variety in the lives, the habits and forms of its tiny inhabitants, while in size there is relatively quite as great a disparity between the largest and smallest species as there is between a mouse and an elephant. The largest known insect is no bigger than a small rat, but this is a giant indeed in comparison with the majority of its kind.

Unusually large insects are not very common: some, indeed, are extremely rare. For among the frailer creatures of the earth, to be in any way conspicuous is a serious handicap in the struggle for life. The smaller, less obtrusive species have a far better chance of escaping destruction, and so, in the aggregate, have been more successful in holding their own and retaining their place in the scheme of Nature throughout the ages.

The larger and more brilliant insects are naturally denizens of those hot, sun-favoured lands where Nature revels in luxuriant growth and gorgeous colouring. Travellers in tropical countries bring back tales of wonderful butterflies rivalling exotic birds in size and splendour; gigantic armoured beetles equipped with fearsome jaws and horns, and other monstrous six-legged creatures.

One of the largest of the giant beetles is the great goliath (*Goliathus Druryii*) an inhabitant of tropical and southern Africa. It is an imposing creature from four to five inches long, and broad and bulky in proportion. Its colour scheme, though simple, is very effective; the horny wing cases folded over its capacious back have a soft, velvety surface, and are a rich chocolate-brown splashed and bordered with creamy white, while the shield protecting the thorax or shoulders is black marked with wide, longitudinal, cream-coloured stripes. The curious flat head, which is slightly convex giving it a peculiar scooped-out appearance, is greyish-white and embellished with two small, black, odd-shaped horns. The legs are a reddish tinge, and the hind pair are fringed with long, silky, golden hairs.

In spite of their size and the powerful toothed claws with which they are armed, these ponderous beetles are harmless, inoffensive creatures. They haunt dense forests, moving slowly and clumsily over the ground, flying heavily round the tops of lofty trees, or feasting upon the sap of various tropical plants, especially a juicy kind of vine that festoons the forest trees of which they are particularly fond. The first stage in the life-history of the goliath beetle is passed hidden in the soil as a huge, fleshy grub. When full fed it fashions for itself a large, earthen cocoon in which to undergo its wonderful transformation into a perfect insect. The



S. Crook

DRAGON-FLY, LARGEST OF BRITISH INSECTS

Though rustic superstition has christened it "horse stinger" the dragon-fly of Britain has no sting wherewith to harm either horses or any other beings. It deals with prey by using its mouth, and the family includes the largest of British insects

S Crook

MALE STAG BEETLE, A GIANT BRITISH SPECIES

Stag beetles, which we may see flying in an August evening with impressive hum and ponderous progress, vary greatly in size according to the nourishment obtained by them in their larval stage. This takes five years to run its course, and is spent in rotten oak. Common in the southern counties of England, an over-all length of more than three inches is not uncommon

cocoon is oval in shape, about as big as a swan's egg, and, probably to strengthen the walls, which are remarkably thin, it is encircled by a solid raised band of the same material, though how a creature that builds its cocoon round itself contrives to form this outer band is a problem that has greatly puzzled many a "scientific gent."

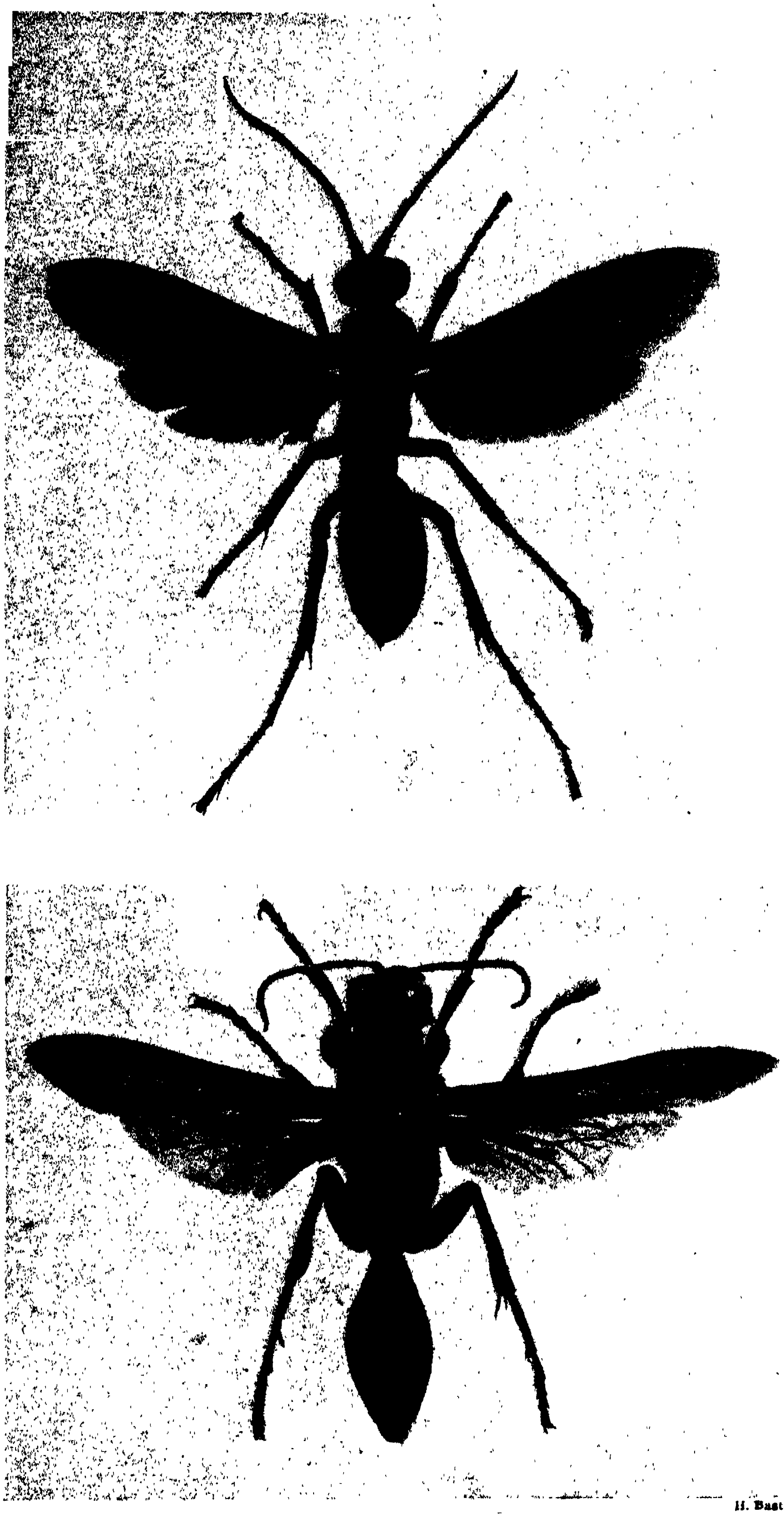
The existence of these giant beetles was not discovered until towards the end of the eighteenth century, when the dead body of a fine goliath found floating down the Gaboon River by a naturalist caused great excitement among entomologists, and as much as £50 was given for a perfect specimen.

IN point of size the goliath beetle is run very closely by several others of his tribe, that, in addition to their large dimensions, are the possessors of the most extraordinary horn-like projections which give them a weird and warlike appearance. Of what use these strange additions to their anatomy are to the insects is a subject that has given rise to much speculation and discussion. The old idea that they were employed as weapons of offence has been practically discarded, as these mammoth beetles are by no means pugnacious and have never been observed to engage in violent combat one with another. The long, sharp horns that rise sometimes from the head and sometimes from the thorax of the insect may, indeed, to some degree, be protective, and of service to their owners by causing would-be assailants to think twice before attacking so well armed a creature; but the generally accepted opinion is that their formidable-looking horns are primarily intended to serve as adornments wherewith the male insects may attract and fascinate the females of their kind, for the latter are hornless, and usually smaller, insects. The suggestion that in some cases the lordly males make use of their horns to seize and carry off a reluctant mate is difficult to authenticate as the female beetle is usually too slippery and active a lady to be coerced in so peremptory a manner.

One of the finest of these giant horned beetles is the hercules beetle (*Dynastes Hercules*), as it is popularly called. This species is a native of Guiana and the West Indies, and measures over six inches, the enormous horn into which the thorax is prolonged accounting for four of them. This horn curves slightly downwards, while a second one, rising from the head of the insect, curves upwards to meet it, thus forming what appears to be an enormous pair of jaws, or pincers. The upper surface of the lower horn is toothed and West Indian natives declare that the beetle can saw off the branch of a tree by seizing it in his " jaws " and whirling round and round it until it is completely cut through! The same " tall story " is told of another species, the golofa beetle of Colombia, which has a very similar pair of horns with saw-like edges.

The male hercules is a decidedly handsome fellow. His wing cases are a deep olive green colour, the head and thorax ebony black and the long upper horn is fringed with a short, dense growth of golden hairs. He is seldom seen abroad during the daytime, as these beetles are nocturnal in their habits, and hide away in dark corners until the evening, when they come forth to feed and fly about in search of mates.

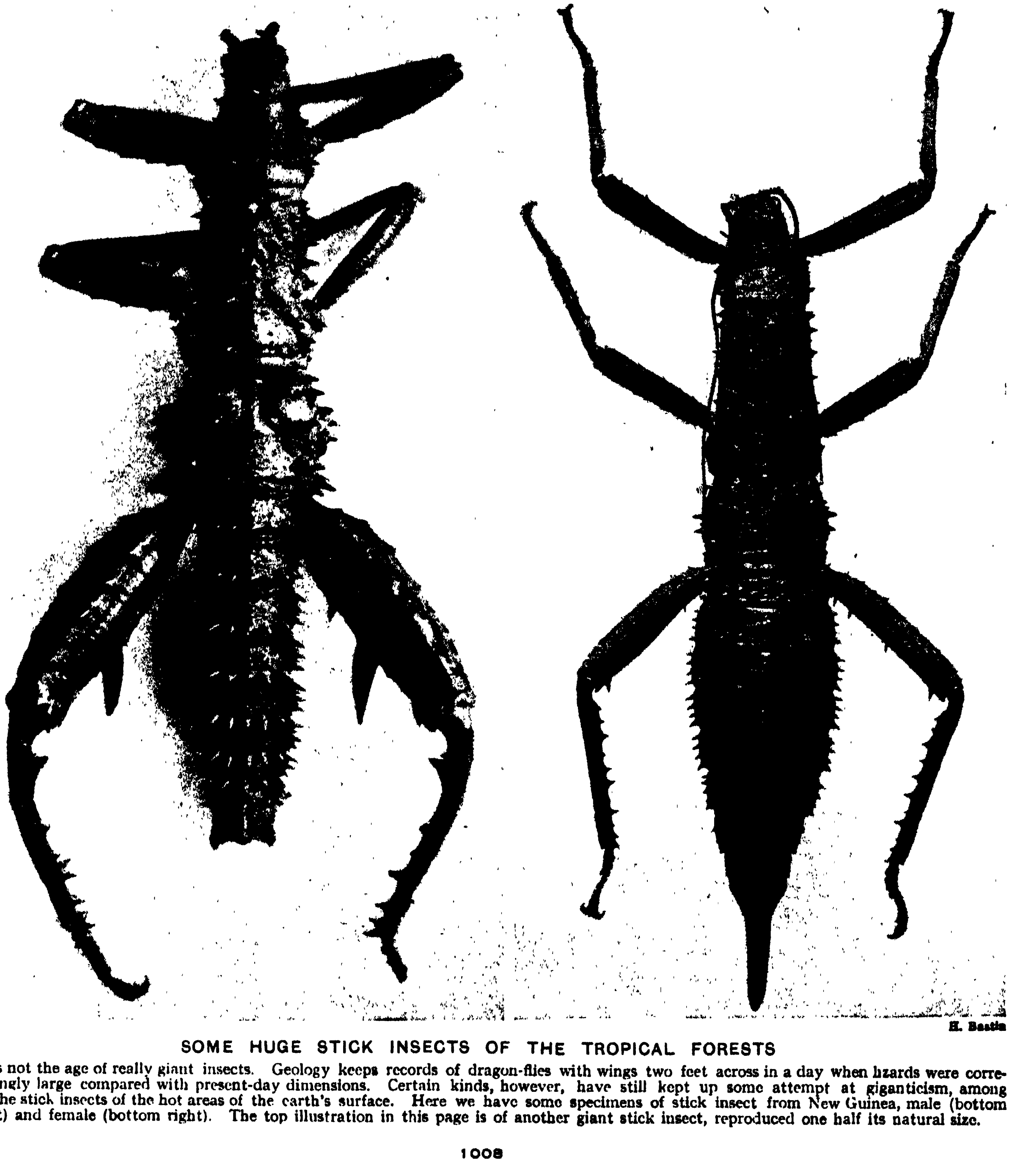
THE elephant and rhinoceros beetles have gained their respective names from the peculiar shape of their horns. The elephant beetle (*Megasoma elephas*) is found in the wooded districts of Colombia. This insect, which is four inches



H. Bastin

GIANT TORPICAL WASPS, NATURAL SIZE

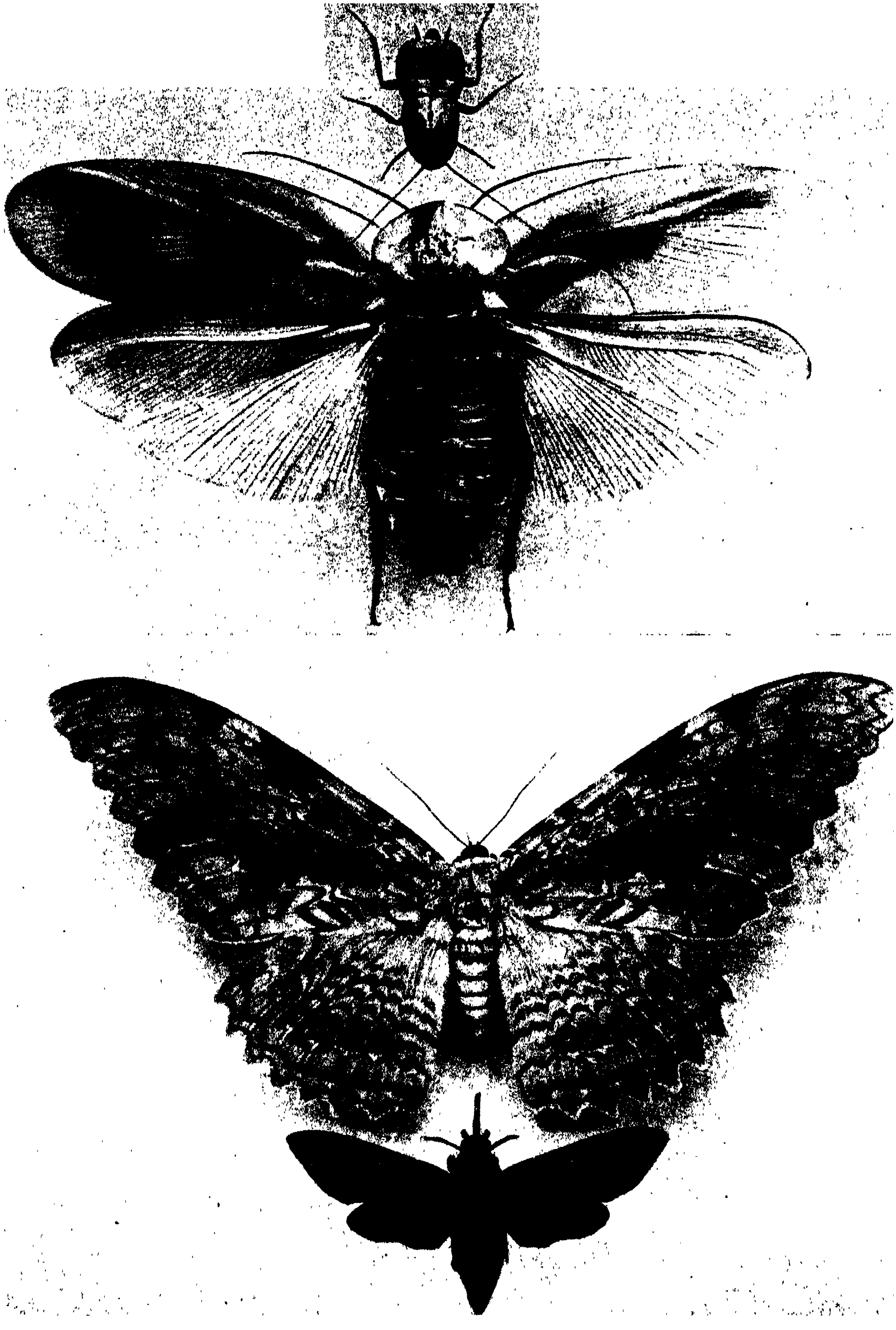
Luckily for the rest of Nature, the stinging insects do not reach such large dimensions as the innoxious kinds but, all the same, these tropical wasps are quite large enough to earn respect. The one in the lower photograph comes from South America, and is a hunter of spiders. In the top photograph is a giant wasp from the Eastern tropics. Both are given natural size.



H. Bastin

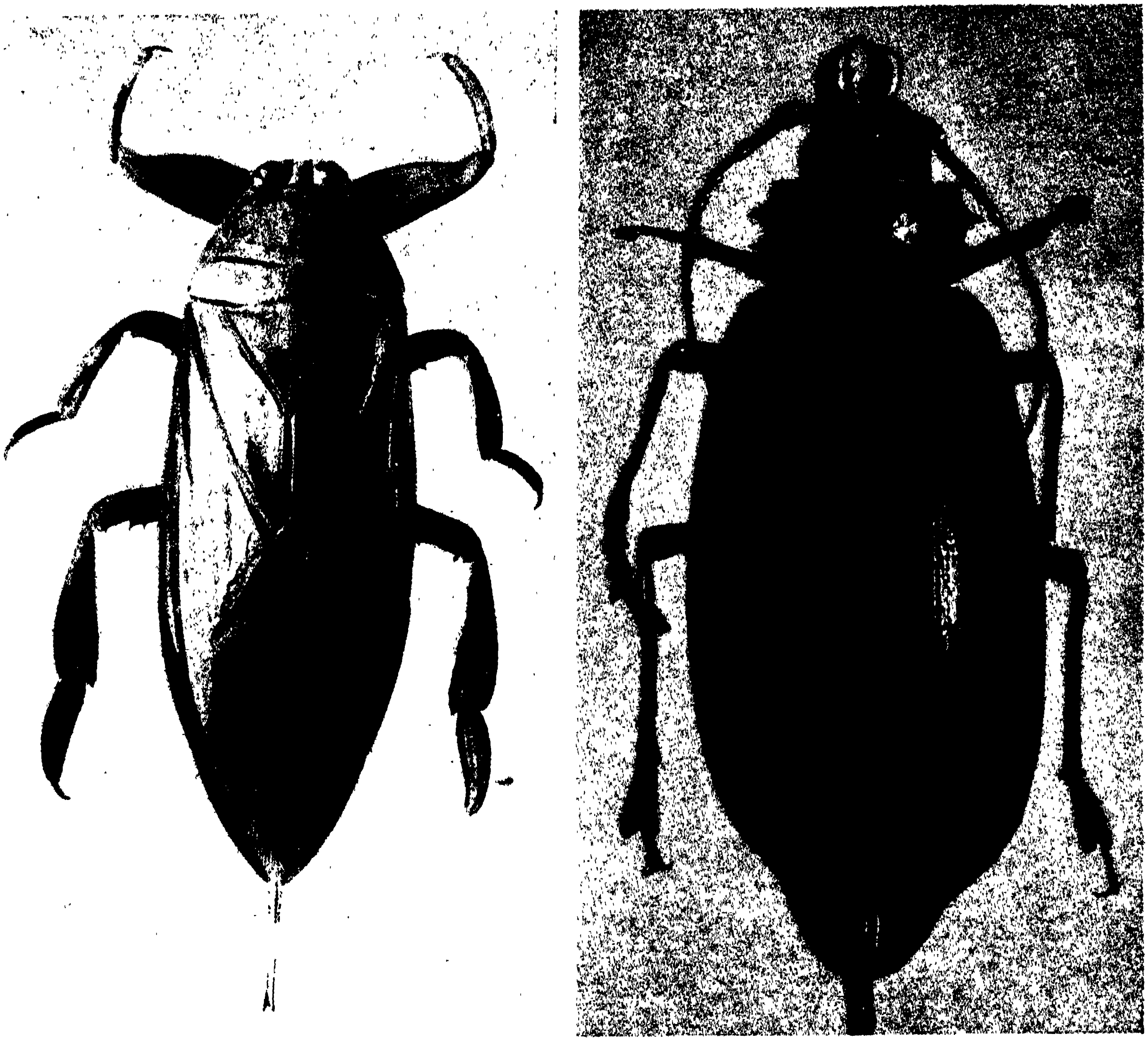
SOME HUGE STICK INSECTS OF THE TROPICAL FORESTS

Ours is not the age of really giant insects. Geology keeps records of dragon-flies with wings two feet across in a day when lizards were correspondingly large compared with present-day dimensions. Certain kinds, however, have still kept up some attempt at giganticism, among them the stick insects of the hot areas of the earth's surface. Here we have some specimens of stick insect from New Guinea, male (bottom left) and female (bottom right). The top illustration in this page is of another giant stick insect, reproduced one half its natural size.



MOTH AND COCKROACH OF THE NEW WORLD COMPARED WITH SPECIMENS FROM THE OLD

Here, the lower photograph shows one of the largest of all the known moths. This is named Thysania and it comes from that rich storehouse of animal curiosities, South America. By way of contrast, and to emphasize the enormous dimensions of this flying wonder, a British moth, the death's head, which is the largest species found in Britain, is shown beneath it. Above is a giant cockroach from the West Indies compared with the common cockroach of England. The latter is nearly always referred to as the " black beetle "



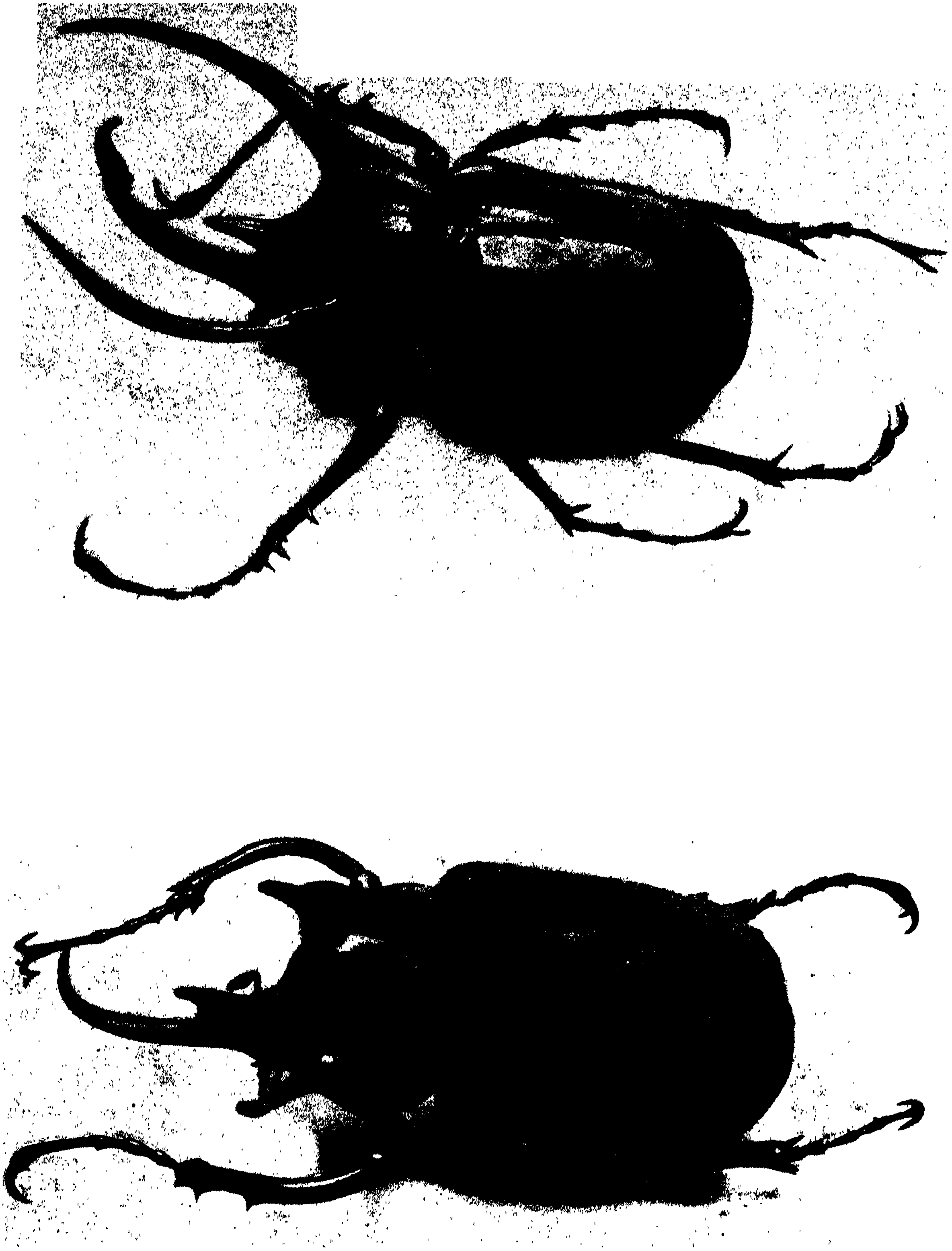
GIANT WATER BUG AND GIANT FOREST BEETLE OF TROPIC LANDS

Some of the giant water bugs, of which we have a fine example here (left), are four inches long and live in the tepid, sluggish waters of hot climates. With their powerful front legs they catch little fish and kill them with their sharp, stabbing beaks. They are strong fliers and, where they breed near large towns, are often seen in great numbers round street lamps. The right hand photograph is of a titan beetle, a a native of Brazil and resembling an enormous stag bettle. The total length may be as much as six inches.

long and two in breadth, carries two horns on its head: a short, upper, lip-like projection and a long under one forked at the tip that curves upwards and has a distinct resemblance to an elephant's trunk. The actual colour of the beetle is black, but its entire upper surface, with the exception of the horns, is covered with a velvet-like pile of short olive-green hairs. This, however, is easily rubbed off, consequently almost every specimen that we examine has several bare patches on its back disclosing the shiny black armour beneath its " fur coat."

THE great rhinoceros beetle (*Xylotrupes gideon*) is a native of Indo-Australasia. It is a grotesque and alarming-looking insect, not unlike the hercules, with an immense pair of pincer-like horns. It is not very much like a rhinoceros, however, so its popular name is not a particularly appropriate one, and is more descriptive of a smaller allied European species (*Oryctes nasicornis*) that is distinguished by having a short, stout horn, curving backwards from its forehead distinctly suggestive of the " nose-horn " of the great quadruped.

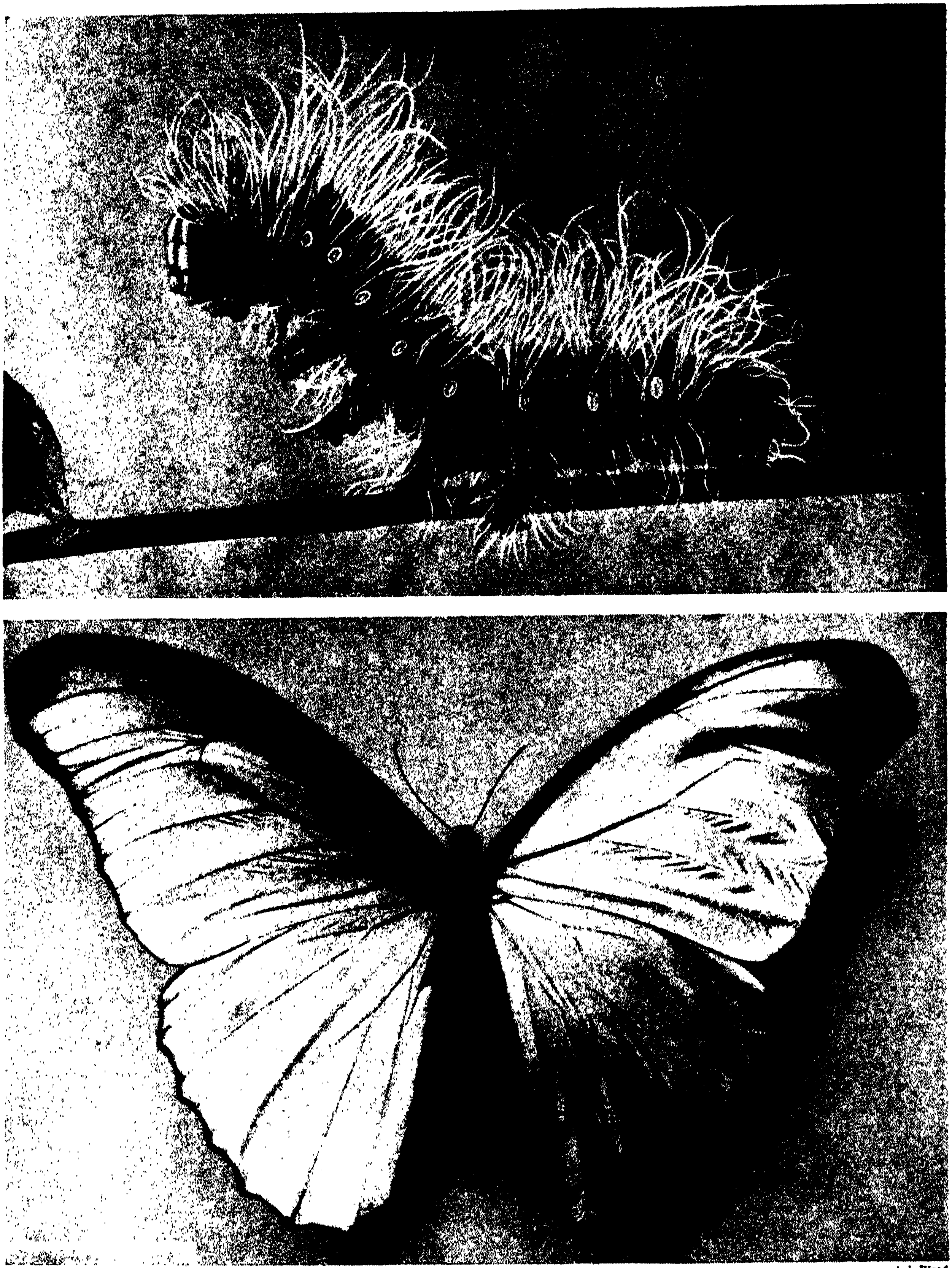
The fore-front of the great atlas beetle (*Chalcosoma atlas*), a gigantic insect of the Malayan regions, fairly bristles with fearsome-looking horns. A sharp, pointed spike in the centre of the thorax and a long, sabre-like affair on each side of it are directed forwards in a menacing fashion; while another, thicker horn beset with spikes, curves upwards from the top of the head. Yet, like the other giants of its tribe, the great atlas beetle is something of a fraud. It is actually a quiet, peacefully-disposed individual, not at all addicted to engaging in warlike conflicts



M. Dunc

ELEPHANT BEETLE FROM SOUTH AMERICA AND ATLAS BEETLE FROM MALAYA

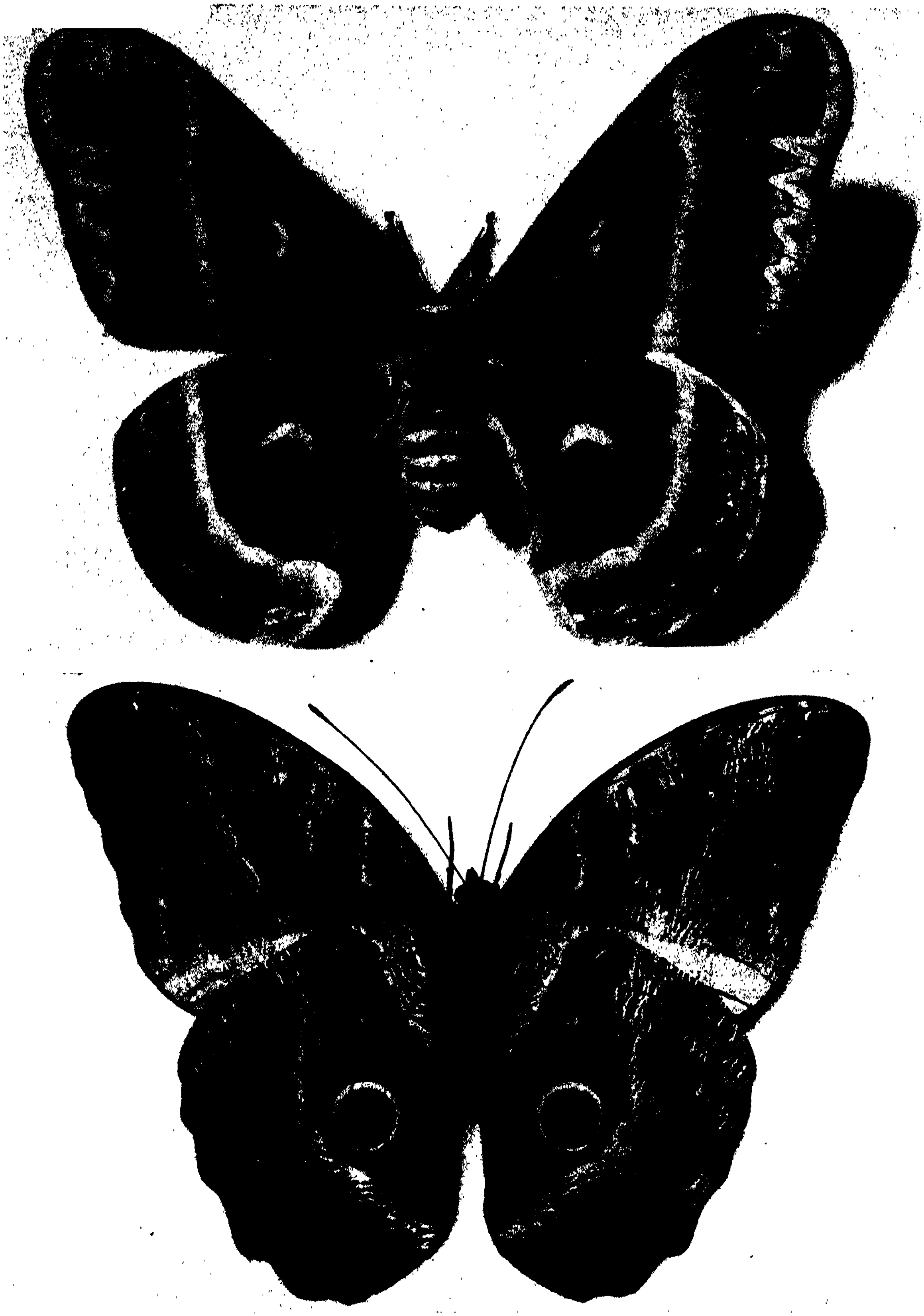
In the dense forests of Colombia is found the huge elephant beetle (bottom), which is some two inches broad and four long. One of the two horns on its head closely resembles the trunk of an elephant. The black back is covered with a very delicate pile of olive-green hairs. This is easily rubbed off, showing the shining black of the wing cases underneath. The upper photograph shows a great atlas beetle from Celebes. Despite its fierce-looking horns it is quite harmless. Both these insects are seen here somewhat reduced in size.



J. J. Ward

MORPHO OF THE JEWEL WINGS AND A MIGHTY CATERPILLAR OF A MIGHTY MOTH

Many who have never seen a live morpho have seen parts of this creature's wings in jewellers' shops. These fragments are put under glass and made into brooches, never losing their brightness since the wonderful colours seen as the wing is turned this way or that are due, not to pigment, but to refraction of light. When seen flying in their tropical South American forests in the tremendous sunshine of those latitudes, the brilliance of colouring is dazzling. Above is a specimen of the huge caterpillar of Eacles Imperialis at the last stage of its growth.



J. J. Ward

BUTTERFLY AND MOTH WITH SMALL BODIES BUT ENORMOUS WINGS

As large as the great morphos (see opposite page) are the big owl butterflies of South America which fly at dusk and display markings on the under surface of their hind wings which are uncannily reminiscent of an owl's face. The resemblance will be seen to be still more striking if the page be held upside down. As it is we are looking at the moth right way up and at the underside. The top photograph shows us a giant silk moth. Compared with the huge wings the bodies of these creatures are very small.

with other males of its own species or interfering with the smaller, less well protected creatures it comes in contact with. This beetle is somewhat long in the leg and is smartly, but unostentatiously, clad in a uniform of dark bronze.

All these giant beetles are closely allied and belong to an important group of Coleoptera known as lamellicorns, or leaf-horns, from the peculiar structure of their antennae—the end, or club of the antennae being composed of a varying number of thin, flat plates which can be expanded or closed like the leaves of a fan. These remarkable sense-organs are seen to perfection in the cockchafers, a well-known family of leaf-horns which has representatives in many parts of the world. Chief among them is the giant cockchafer of Assam, a noble insect, three inches long in the body, with an extraordinary pair of front legs over two and a half inches in length, and armed with two long sharp spurs, the second of these alarming-looking projections having a kind of secondary spike, or movable claw at the tip. These weapons and the saw-like edges of the thoracic shield make the giant cockchafer an uncomfortable creature to handle; and it must be anything but pleasant to have one of these enormous insects blundering against you after the clumsy manner of its kind, as it buzzes about in the evening, bumping into everything in its way. It is, of course, only the male cockchafer that has these curiously spurred legs; the female is smaller and unarmed; but both are handsome insects. The dark green wing cases have a sheen of gold bronze, while the head, thorax and legs are a brilliant metallic green, shot with copper.

In the dense tropical forests, where most of the gigantic leaf-horns live, these beetles do much useful work in attacking old and fallen trees, so hastening the natural process of decay by which the great trunks and boughs are converted into vegetable mould; for although the food of these great insects consists chiefly of the sap of plants and the nectar of exotic flowers, the larvae of all the species spend their days in consuming vast quantities of rotting wood and decaying vegetation. These great "white worms," as they have been called, grow to an immense length, and are most repulsive-looking things; but they are seldom seen, as they carry on their work in total darkness—hidden in the ground, among the roots of old trees, in decaying tree trunks and branches, or under piles of débris on the floor of the forests. They are dull, heavy creatures, moving only when they have destroyed everything in their immediate neighbourhood that can be attacked with their strong, horny jaws, and the rapidity with which they demolish everything eatable in their vicinity is astounding.

This, of course, is all to the good when the operations of the insects are confined to wild, overgrown, wooded regions, which (if it were not for the ceaseless industry of these vast armies of indefatigable workers) would in the course of time become impenetrable wildernesses of piled-up dead and dying vegetation; but when these big beetles invade cultivated areas the activities of their unattractive grubs are the reverse of beneficial, and considerable loss is sometimes caused by their ravages in timber plantations and coconut groves.

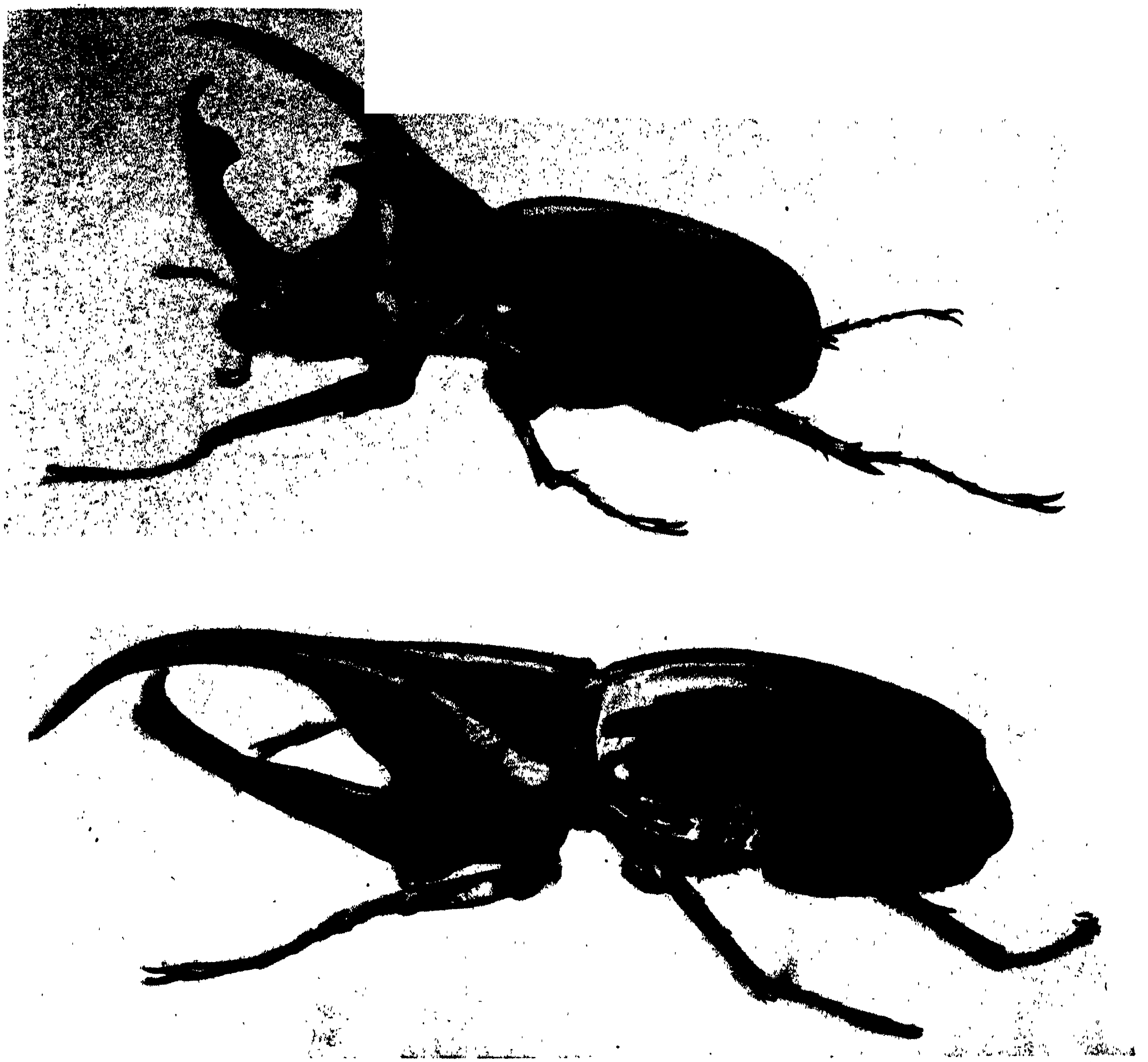
Another interesting tribe of wood-boring beetles is that of the long-horns (*Longicornes*), distinguished by having long, sometimes extraordinarily long, antennae. They number among their species several that are of heroic proportions. One of them, *Titanus giganteus*, a native of Brazil, equals the giant goliath in length and breadth, although the latter is, perhaps, the heavier of the two insects. The titan is entirely black, with a satiny sheen, and looks like a gigantic stag-beetle. A fine specimen may measure half a foot in length—if we include the enormous pair of toothed jaws with which it confronts all comers. When these jaws are closed the two sharp points cross each other and the formidable teeth fit closely together, so a spiteful nip from this terrifying insect is not to be encountered lightly.

Another tropical American species (*Masrodontia cervicornis*), popularly known as the sawyer beetle, is nearly, if not quite, as big as the titan, and is, moreover, a startling-looking creature attired in black and yellow. It is further distinguished by having one long tooth in the centre of each jaw and about sixteen smaller teeth on each side. In an ancient Natural History the following quaint description of the insect is given: "It hath a little broad head, great oxe-eyes, almost three fingers overthwart in length; it hath a forked mouth, gaping and terrible, with two very hard, crooked teeth; with these while he gnaws the wood (I speak by experience) it doth perfectly grunt aloud like a young pig."

That the sawyer beetle does make a grunting noise with its strong teeth while energetically engaged in sawing away at the branch of a tree is highly probable. It is said to "girdle" the branches, gnawing through the bark all round, in order to enjoy the sap. These branches, which are often already hollowed out by the larvae of the beetle, naturally snap off sooner or later and fall to the ground, and thus the "sawyer" has gained a reputation of actually cutting off the boughs of forest trees.

In contrast to these grotesque giant beetles we have the glorious tropical butterflies—world-renowned for their size and the beauty of their colouring. They are the treasures of many a collector's cabinet, but to realize the full glory of these brilliant, graceful insects we must see them in their natural haunts, gliding down the glades of South American forests or fluttering through wooded regions in far-Eastern lands where they rival the most gorgeous exotic flowers. It is the wonderful wings of these butterflies that entitle them to rank among the giants of the insect world; their bodies in proportion appear surprisingly small.

The bird-winged butterflies, fit associates of the bright-hued birds of paradise, are found chiefly in the Malay Archipelago. They are magnificent creatures measuring from eight to nine inches from



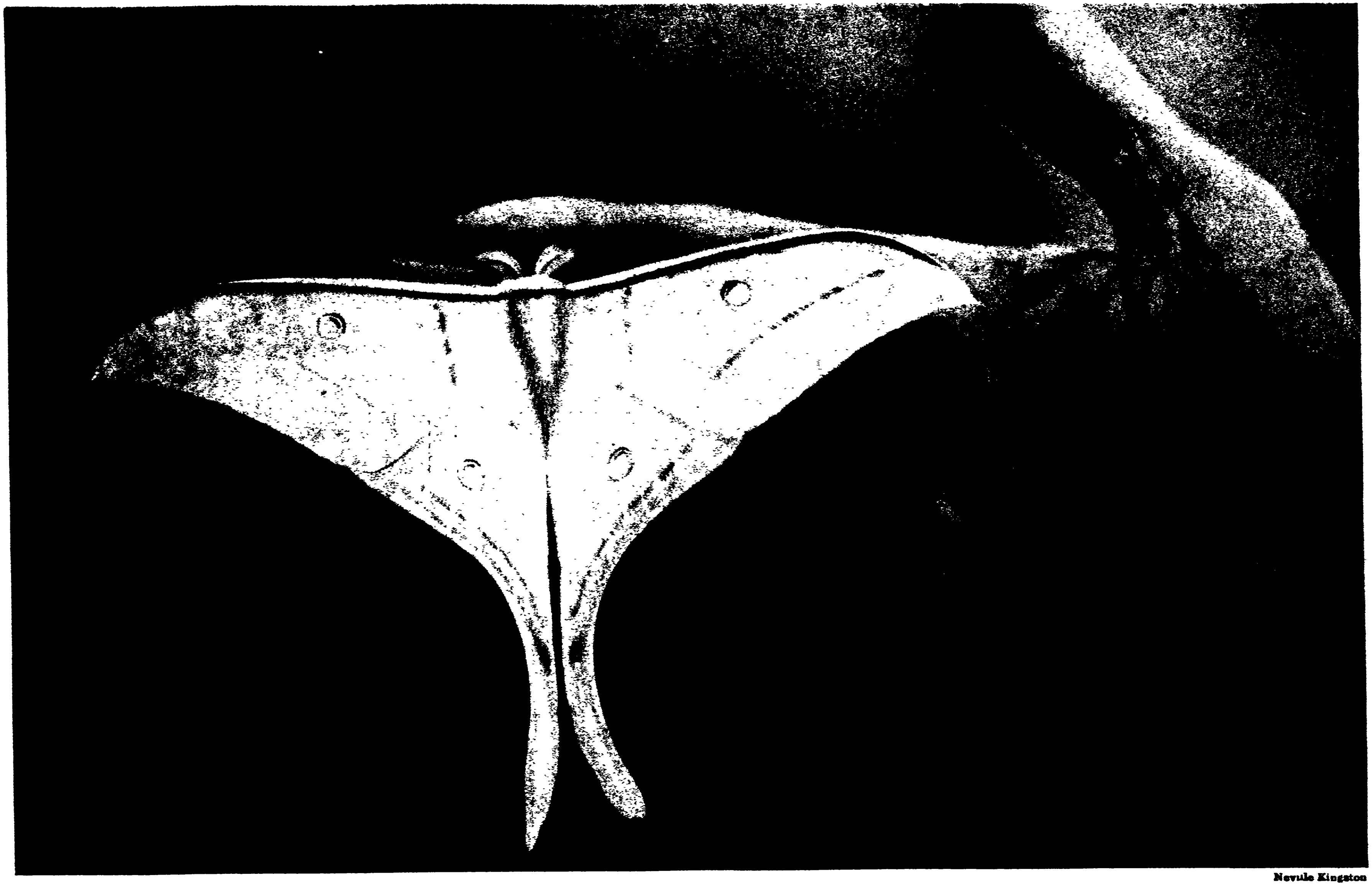
Martin Duncan

RHINOCEROS BEETLES OF INDO-AUSTRALASIA AND WEST AFRICA

Though not very much like a rhinoceros this beetle (bottom) of Indo-Australasia is an impressive creature with its bulk and its immense pair of pincers. Its appearance is at once grotesque and alarming although in its behaviour it is harmless enough. In fact beetles, large or small, though they give rise to much fear are innocuous creatures so far as human beings are concerned. The upper illustration is of another kind of so-called rhinoceros beetle, and it comes from the forests of West Africa.

tip to tip of their expanded wings, which are usually long and narrow—like the wings of a bird. Some species have most glorious blue-grey wings; others are velvety black, splashed with scintillating green and gold; some have wings that appear to be made of copper. These brilliant "bird-wings" are male butterflies. The females as a rule are not so brightly coloured, though they are even bigger than their mates, some species being quite twelve inches across the wings. In the Malayan forests and wooded mountain ranges, too, great "ghost butterflies" with pale semi-transparent wings dotted with black, flit silently and mysteriously about in the twilight. Most famous of South American butterflies are the great morphos, whose wonderful blue wings are so much used in jewellery. In the sunshine they are absolutely dazzling in their brilliancy and change in colour with every movement, turning, as the light falls upon them, from deepest blue to palest azure. At one moment the two wings on one side may be dark brown, while the opposite pair glitters like blue fire; again, all the wings are blue shot with yellow and brown, or brown rippled over with blue flames, then suddenly all light and colour disappear from the wings and they look almost white.

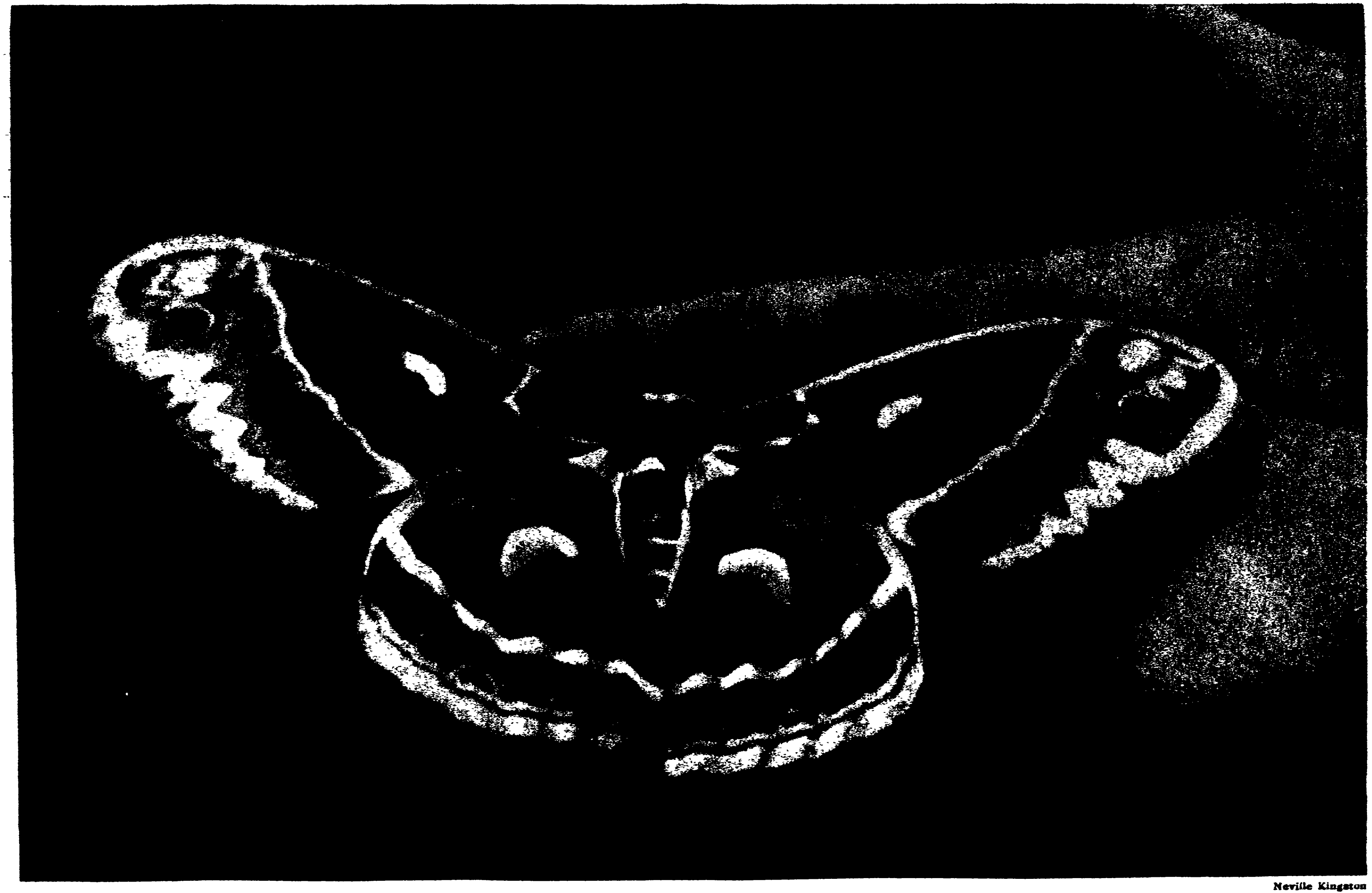
There are several species of these giant morphos, all peculiar to the great South American forests, where they may be seen gliding low with their wonderful wings outstretched down the open glades, or flying aloft, a hundred feet above the ground, with an



Nevile Kingston

WIDE-SPREADING WINGS OF PALEST GREEN DISPLAYED BY A BEAUTIFUL MOON MOTH

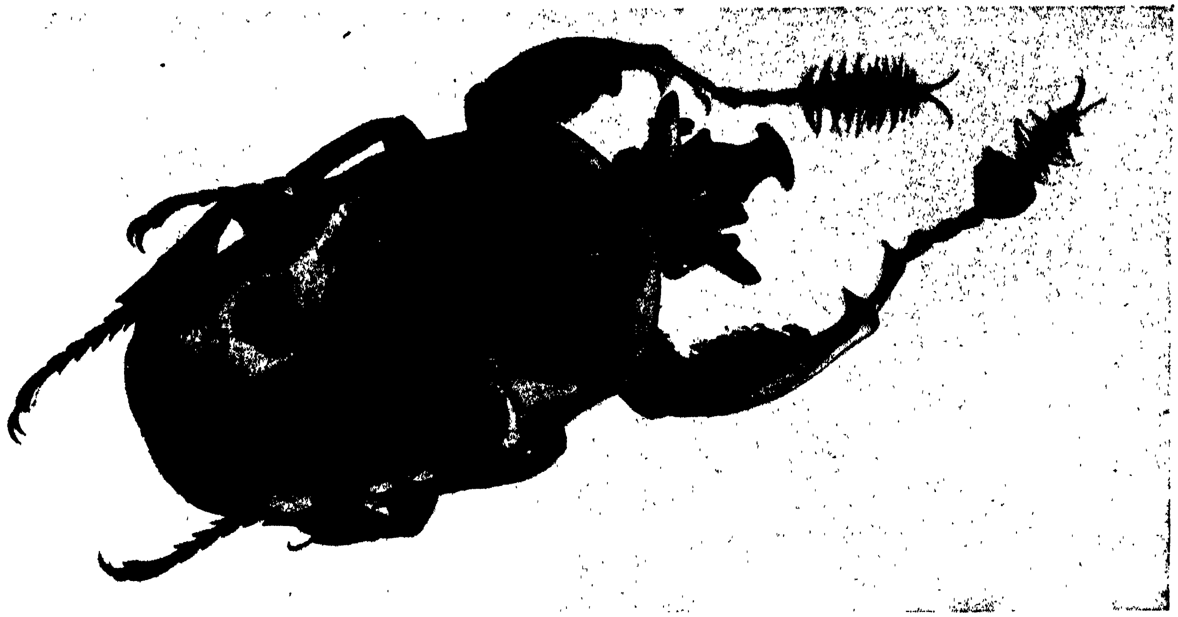
Large in area but most daintily shaped and elegantly ornamented, the wings of the great moon moth are things of beauty. In this photograph, taken at the London Zoological Gardens, a specimen of the beautiful moth is seen just after emerging from its chrysalis. The delicate wings with their slender trailing tails are freshly unfolded to the sun and the insect is photographed on the hand of the keeper, who has just picked it up to watch the very last stages of preparation for the creature's winged life. Seen thus compared with human fingers we get a good idea of the large size of this moth. It is found in America and also in the Orient, the latter being probably its true home.



Neville Kingston

BIG CECROPIA MOTH OF NORTH AMERICA NEWLY EMERGED FROM ITS COCOON

It is not always realized that there is as great a disparity in the relative sizes of insects as there is between, say, the mouse and the elephant. Some insects are so small as to be mere specks to the human eye while, at the other end of the scale, the moths can produce titans. These are found in the warmer parts of the globe, where the heat of the sun and copious rain provide an abundance of food. The Cecropia moth, of which we have a specimen above, is from wing-tip to wing-tip as big as a man's hand, the wings being handsomely marked with grey, white and red. The big cocoon is about three inches long, and the caterpillar which spins it is a sturdy creature, and coloured green with blue and pink-red tubercles.



M. Duncan

MALE OF THE CHEIROLASIA BEETLE WITH ITS TUFTED FORELEGS

Although to speak of a giant insect may seem to be rather a contradiction in terms, yet, when we consider the insect world by itself we shall see that, relatively, some of its members are giants indeed. These giants do not attract any general attention, because most of them live in tropical forests, and pass unnoticed in the luxurious vegetation amongst which they lurk. Our photograph shows the beetle Cheirolasia brukei which is brown and black with cream-coloured markings. This specimen is a male, as is shown by the hairy tufts on the forelegs.

undulating flight and occasional flapping movements of the wings. So conspicuous are these butterflies in the sunlight that it is said that the larger species can be seen flying a quarter of a mile away.

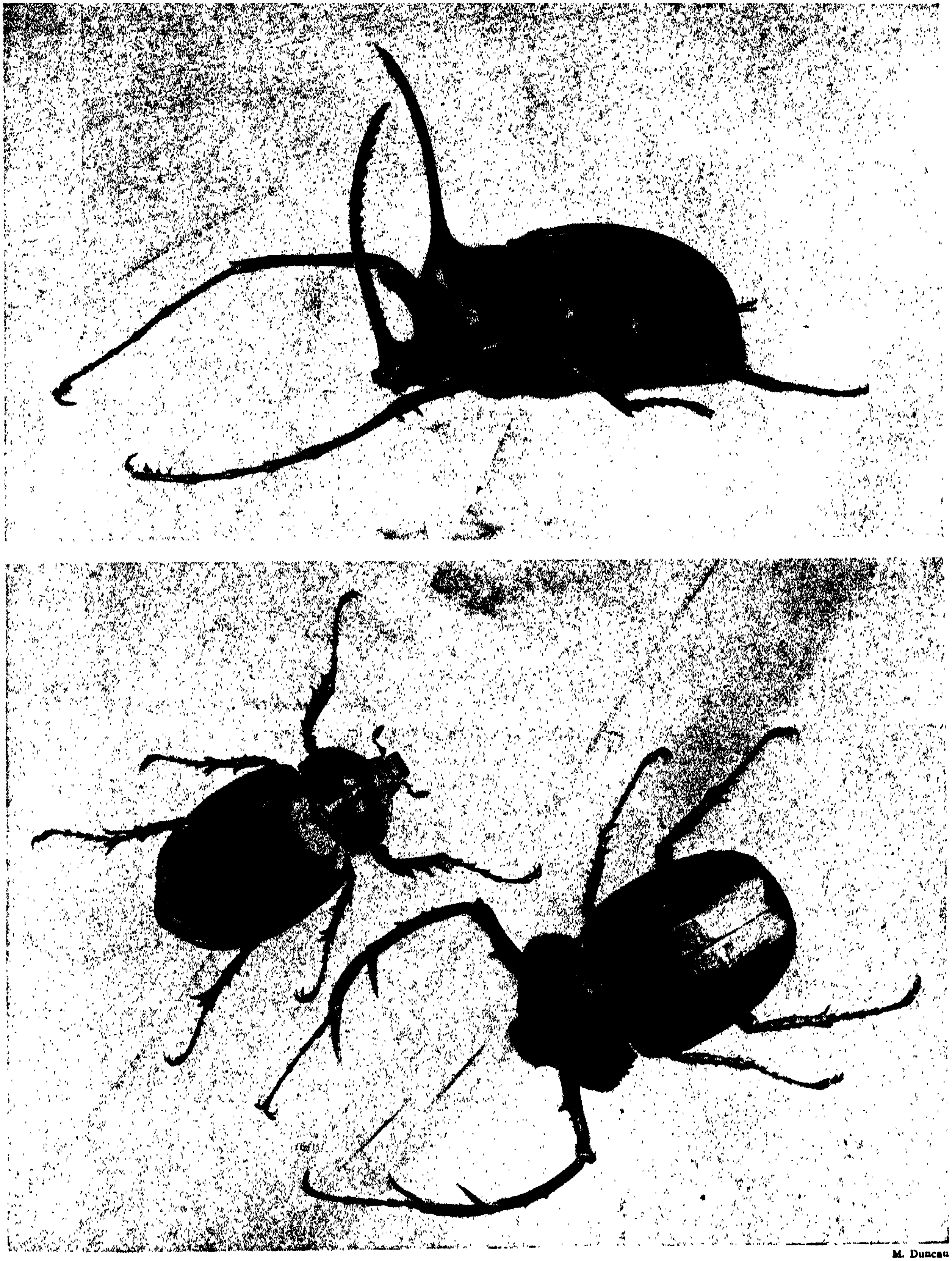
Another South American butterfly, equalling the largest of the morphos in size, is the great owl butterfly. Like the bird of ill-omen after which it is named, it flies at dusk, when the two great eye-spots on the under surface of the hind wings give the insect a strangely owl-like appearance in the dim light. When it comes to rest on a tree trunk, however, the resemblance is not so striking, as when the wings are folded over the back in an upright position only one " eye " can be seen at a time.

Even bigger than the owl butterfly is the huge owl moth of Brazil, whose soft grey-mottled wings, when expanded, measure nearly a foot across, but as they are not remarkable for their breadth, first place among the giants of their kind must be awarded to the atlas moths, whose wings are quite as long and proportionally broad. The atlas moth is an Eastern species of silk moth found throughout India, China and Java. It is a handsome, tawny-coloured insect with a large, triangular, transparent spot on each wing, and the immense silken cocoon it constructs is very valuable.

MANY of the larger locusts are big, heavy insects, often of grotesque form. The uncanny-looking weta-punga of New Zealand totals some fourteen or fifteen inches in length when its extraordinarily long hind-legs and antennae are stretched out—though the actual body of the insect is rather less than three. This creature, which is wingless, climbs tall trees with great agility and sits perched up upon the topmost branches surveying the surrounding country with its great, goggling eyes what time it contentedly munches the young, green leaves. If disturbed, the weta-punga makes a peculiar clicking noise by a slow movement of its hind-legs—apparently to warn off the intruder. When seized, it kicks out vigorously with its powerful hind-legs, inflicting painful wounds on its captor's hand with the sharp spur with which they are armed.

Among the stinging insects there is none that actually deserves the title of " giant." On the whole this is just as well, for imagine the effect of a sudden onslaught of a contingent of infuriated wasps each as big as a titan butterfly, or a swarm of bees as large as atlas moths ! The hornets, that measure about one and a half inches from head to sting are, fortunately for us, the largest social wasps we are likely to encounter ; while the violet carpenter bee of Southern Europe (a noble insect with a velvety black body and violet-tinted wings), though bigger than the largest bumble bee, does not reach terrifying proportions. This fine bee, moreover, is a solitary, peaceful individual that spends its working life industriously boring tunnels in old tree trunks, wherein to deposit eggs from which the offspring it will never see will eventually emerge to carry on the family traditions by becoming skilled carpenters in their turn.

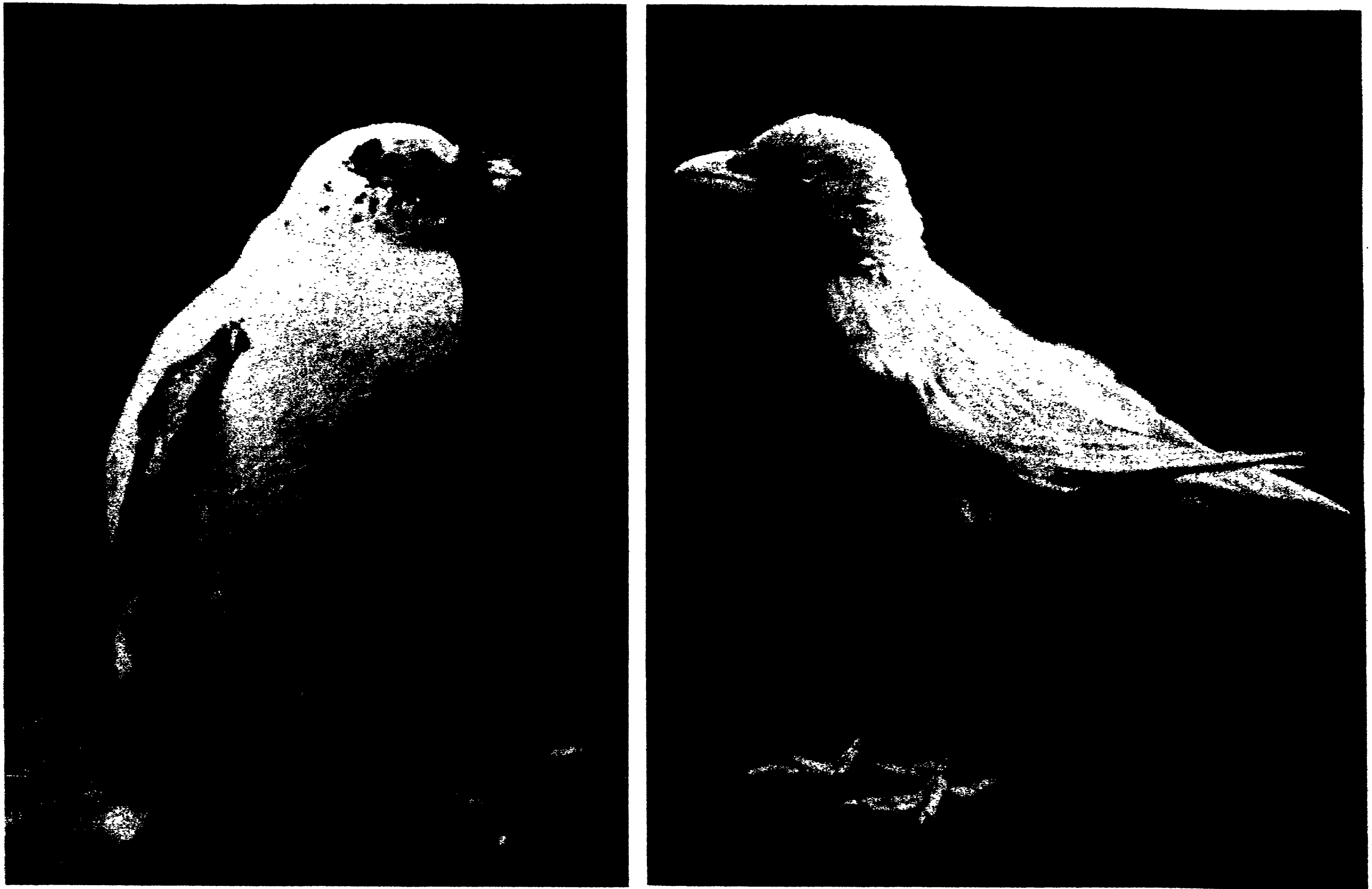
In temperate climates insects seldom reach large dimensions. Most British species are small or of moderate size. Among the two or three exceptions the great green dragon-fly with its long, brightly-coloured body, iridescent gauze wings and great lamp-like eyes, must be given precedence. To see this superb insect hawking over a quiet, reedy pool is one of the delights of the countryside.



M. Duncan

GIANT COCKCHAFERS FROM ASSAM AND A COLOMBIAN BEETLE

Assam produces a giant cockchafer and we show here (bottom) two specimens, a male (right) distinguished by his immense front legs, which are spiked, rather like the antlers of a deer, and end in sharp claws, and a female (left) which is smaller and has a narrower and more compact head. The upper photograph is of the beetle Golofa porteri from Colombia. Two remarkable horns with saw edges rise from the head in a vertical and threatening manner. This insect is shown three-quarters natural size and the cockchafers one-half natural size.



W. S. Berridge

Neville Kingston

MYSTERIOUS ALBINISM AMONG THE BIRDS: ALBINO CAPE PENGUIN AND JACKDAW

Abnormalities ot coloration are not uncommon in bird or beast, but albinism is something quite different. It is not a matter of colour variation, but of the absence of colour due to some deep-seated and inherited tendency. This expresses itself in the individual's lack of the pigment which always develops in normal specimens of the individual's race. A general whiteness is by no means true albinism, but may result from a force which inhibits colour in certain parts of the body. The penguin seen above (left) is possibly an example of this, while the jackdaw (right) is a true albino. Experiments have still to be made to complete our knowledge of this animal mystery.

Chapter XCII

The Mystery of Albinism

By Geoffrey Lapage

Head of the Zoology Department, University College, Exeter

THE lay reader of scientific books sometimes tells the man of science that his work would be more interesting and fascinating and easier to understand if it did not contain so many difficult scientific terms; and no doubt he is right in some degree. The mistake he makes is to suppose that the aim of science is to be interesting or charming or easy to understand, or that the man of science himself enjoys the strict use of terms that are precise and frequently ugly and not English. For certainly he does not. He often sighs to try his wings as a literary artist, but he knows that to yield to such a temptation would endanger that accurate statement of fact and law that is the very breath of a science. He must not, in other words, use the method of the artist or attempt the artist's aim. In this sense science and art can never meet, however desirable their cooperation may be in other ways.

The term Albinism is a good example of the kind of word to which exception may be taken. It is not a pleasing word; it is not even English, being derived from the Latin, *albus*, white. But if we discard it and speak of whiteness, or white colour in animals and plants, we at once find that we are unable to distinguish clearly enough between the different kinds of whiteness that exist. There is, for example, the white colour of cave-dwelling animals such as the cave-newt or olm (*Proteus anguinus*), which lives in the underground waters of Carniola and Dalmatia. This creature is white because it is never exposed to the stimulus of light. For the same reason the tapeworm or roundworm living in a bath of food in the dark intestine of a man or a horse is deficient in colour because light never reaches it. Other examples of this kind of whiteness will occur to the reader. But this is not true albinism.

G. Hearn

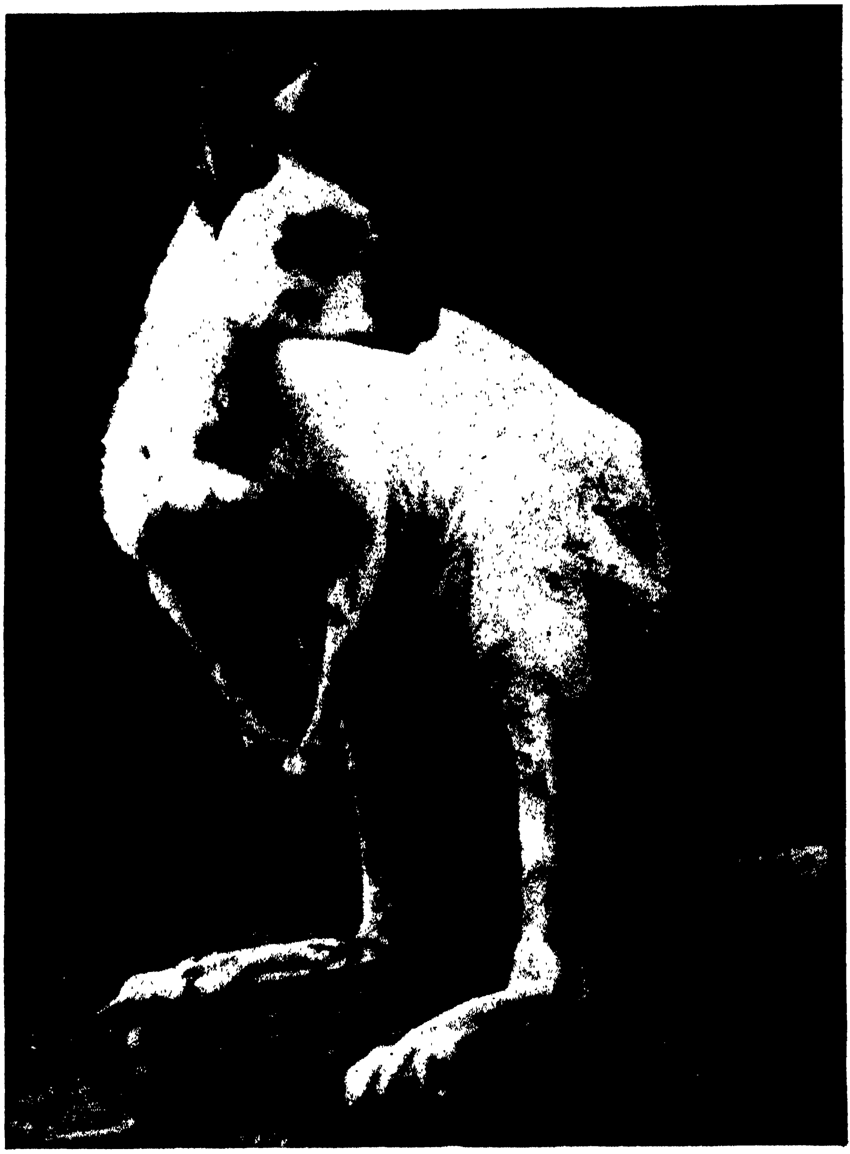
A PARTLY WHITE BLACKBIRD

This bird has endeavoured unsuccessfully to make the old paradox about the white blackbird come true. Real albinism, of course, can show no signs of colour, for albinism means the lack of colour. But there has been some albinism in this bird's pedigree.

Another kind of whiteness is a sort of protective coloration—a response by the animal to the colour of its environment precisely similar to that of the coloured chameleon or frog. If a plaice is put upon a ground in which white patches are prominent, it reproduces on its upper flattened surface a pattern of white patches so like those of the ground that it is very difficult for even that marvellous optical detective, the human eye, to see the fish. A similar reaction is the assumption of white winter coats by the Arctic fox (*Canis lagopus*), the mountain hare (*Lepus variabilis*), the stoat or ermine (*Mustela* (*Putorius*) *erminea*), the ptarmigan, the willow grouse and some other species.

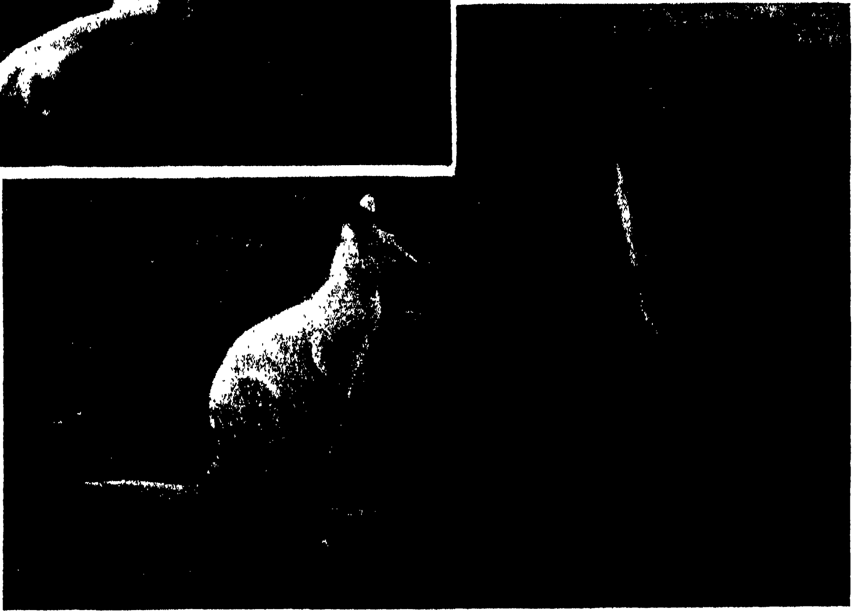
IN the winter, when the white snow covers the world in which these animals live, they assume a snow-white coat which renders them less conspicuous and so enables them either to hide from their enemies or to stalk their prey more successfully. How this change is effected is not clearly understood. The mountain hare is said to moult its summer coat completely, including the under fur, and then to grow a new white one; but this has been denied. The whiteness of the American hare may be due, in part at least, to the appearance of gas in the substance of the longer hairs at their tips, so that the rays of light are scattered by the surfaces of gas bubbles. In addition new hairs, white from their first appearance, probably grow in the autumn. It is said that the ptarmigan's autumnal feathers actually become white, but whether moulting and replacement of coloured by white feathers also occurs, is not clear.

Such seasonal changes to whiteness do not, however, constitute true albinism. They never produce absolute whiteness, some colour always remaining, notably in the eyeballs where it must be vitally important to the retention of the keen sight which is essential to wild creatures. The glare of the white snow, moreover, must increase the intensity of the winter light, and especially of winter sunlight, so that pigmentation of the eye must be even more necessary then than in the summer. We shall see that in true albinism colour is absent



contains a factor which prevents the development of colour in them, or lacks one or other or both of two factors whose co-operation is always necessary if colour is to appear. A true albino, therefore, does not possess the pigment which normally develops in the tissues. Not only is the pigment which is normally present in the skin and other superficial parts not developed, so that the skin, for example, is pink because the red blood in its blood-vessels is not masked by other colour, but even the pigment normally found in the deeper tissues. is absent, also. The lack of external colour is particularly noticeable in the eyeball. The iris is colourless, and the eyeball itself also lacks pigment and is therefore pink for the same reason that the skin is pink, namely, because the red blood in its blood-vessels is not masked by other colour and is visible as the pink glow familiar to anyone who has kept pet albino mice.

Into such an eye more light must enter than into the normal eye protected by



ALBINO KANGAROOS COMPARED WITH NORMAL ANIMALS

Wild kangaroos are very difficult to approach and the lower illustration is a very remarkable photograph indeed. It shows two wild kangaroos in some long grass and one of them is an albino. Thus we get not only an example but an excellent comparison. The upper illustration shows us a captive kangaroo which is a true albino of the great kangaroo.

from the eyeball as from other parts of the animal's body.

It is obvious, therefore, that whatever our objections as writers or as readers to scientific terminology, there is real reason and necessity for it. We must distinguish between several kinds of whiteness and albinism is the name given to one particular kind of it, and to one only. When we write of it, therefore, any reader, whatever his nationality, knows that we are writing only of those animals or plants which, for some reason not yet fully understood, are white because their hereditary constitution either pigment. Albinoes are, therefore, abnormally sensitive to light. The human albino, for instance, shows what is called the albinotic facies, characterised by nearly closed eyelids, and peculiar blinking movements and puckering of the skin round the eyes. Most human albinoes also suffer from a kind of nystagmus which may depend, in some as yet unknown way, upon the absence of pigment from certain areas of the brain concerned with the control of eye movements. The pink eye, with its attendant disadvantages, is thus characteristic of the true albino and by it we can distinguish albinoes from such temporarily white animals as the ermine and others mentioned above which retain the coloured eyeball.

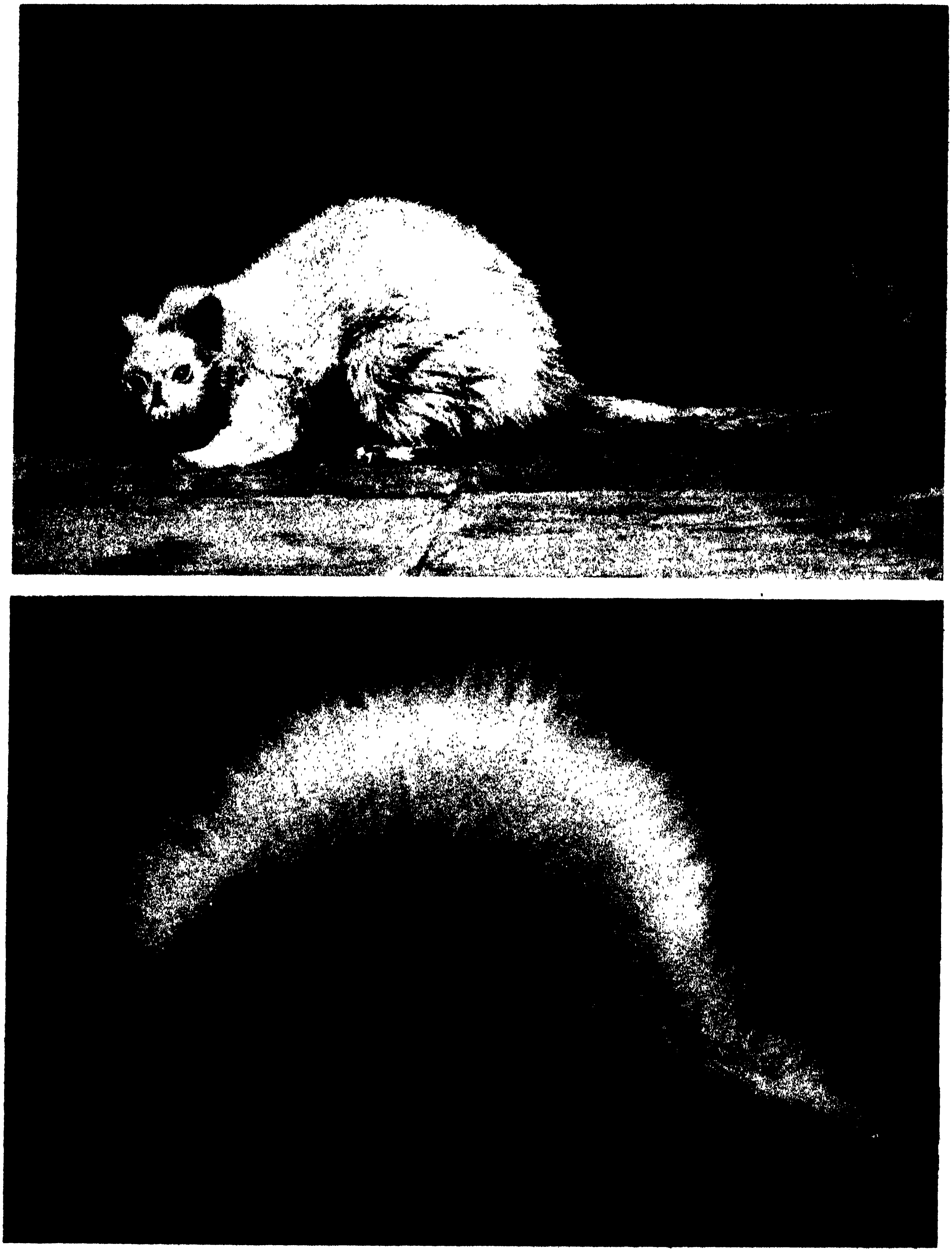
ANOTHER feature of the albino is that it breeds true to its albinism. If two albinoes are mated together, the offspring will all be albinoes also. This is due to the same cause as that which made the parents albinoes, namely, either the absence from their hereditary make-up of one or both of those factors without whose interaction colour cannot develop, or the presence in their inheritance of a factor which prevents the appearance of colour.

What these factors are we do not yet understand. But from the skins of coloured rats and rabbits and guinea-pigs, from the blood of insects and the ink-sac of cuttle-fishes, a ferment called tyrosinase has been extracted which converts chromogenic substances also present in the blood into melanin-like pigments. It is

W. S. Berridge

ALBINISM AMONG THE CARNIVOROUS MAMMALS

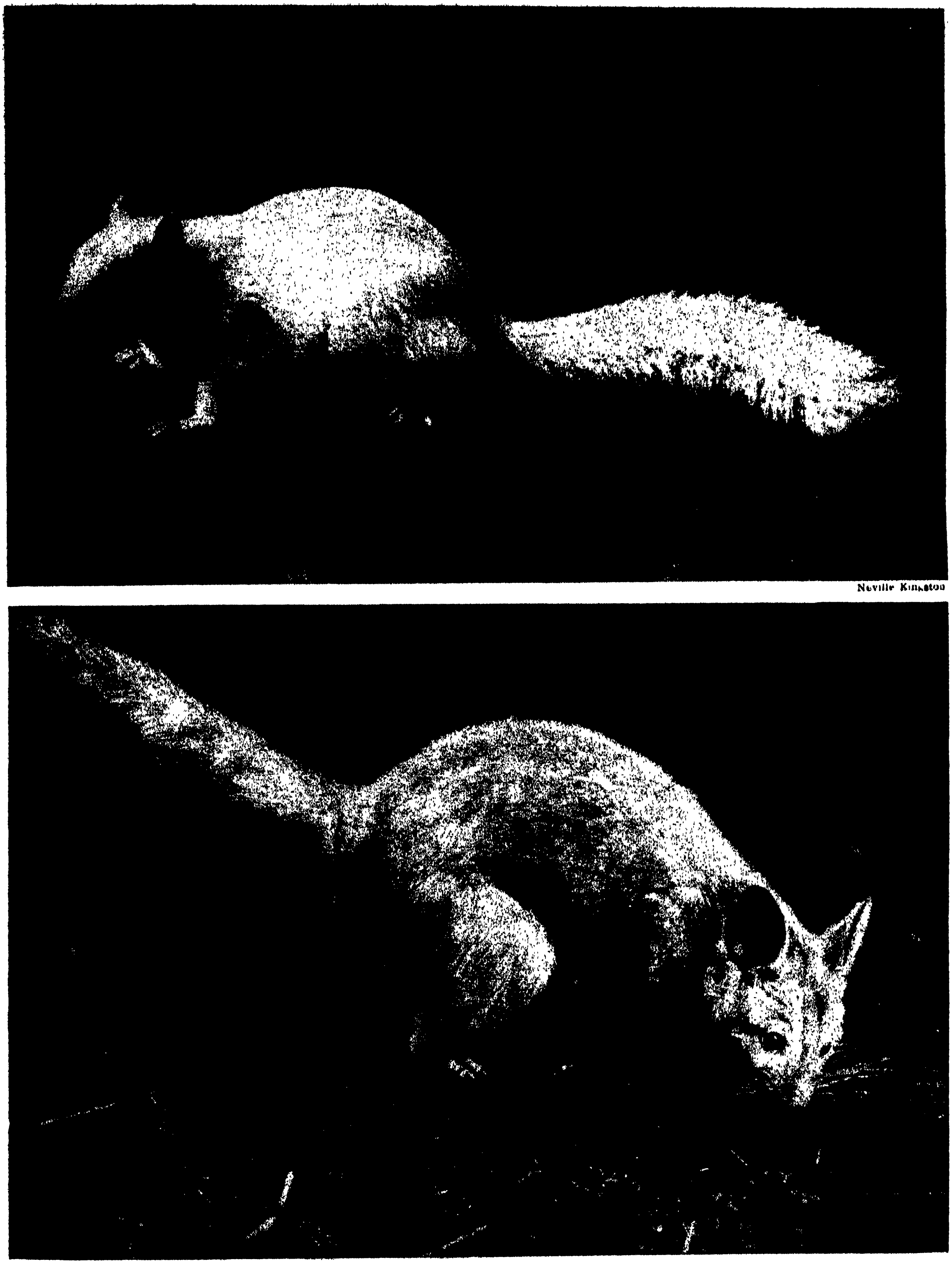
Here is a wolf (bottom) which is an albino, while above we have a remarkable photograph of an albino coyote on the edge of a precipice. This wonderful "snapshot" was taken by night with the aid of flashlight and the white fur shows stark against the blackness of the night in this wild place. So might the lightning have revealed one of the ghost animals of legend.



Neville Kingston

WHITE TREE PORCUPINE AND A WHITE MALAYAN PALM CIVET

Tree porcupines are not only covered with sharp quills but with long hairs and the latter almost entirely obscure the former. The absence of pigment affects, of course, quills and hairs alike as we can see by the specimen in the lower photograph, which does not show a particle of colour. Above is a palm civet from Malaya. This too shows itself a complete albino from the tip of its nose to the end of its extremely long and twitched-up tail. Ordinarily the markings of the palm civet show strong contrasts.



Neville Kingston

ALBINO OPOSSUM FROM AUSTRALIA AND AN ALBINO SQUIRREL FROM SUSSEX

The word albino is derived from the Latin word *albus*, meaning white. But all white animals are not albinoes. The true albino owes its peculiarity either to the absence in its heredity of one or both of the factors whose interaction causes colour to develop; or the presence in the inheritance of a factor which inhibits colour. What these mysterious factors are is not yet certain, but in the blood of certain coloured animals certain ferments have been found which are never present in the blood of albinoes.

W. S. Berridge

Nevill Kingston

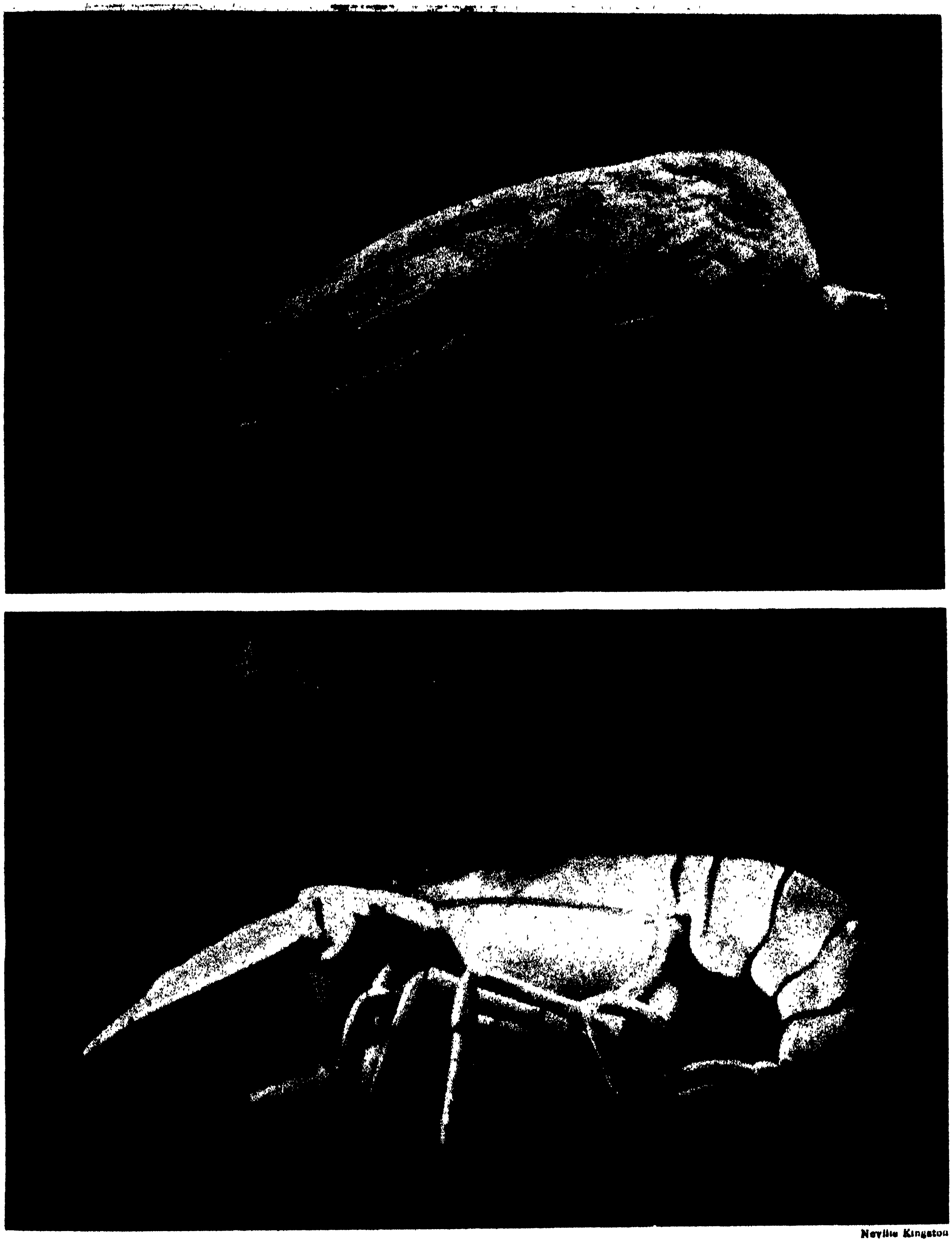
RARE WHITE COBRA AND WHITE ELEPHANT

Below is a white cobra in the possession of the London Zoological Society. It is rarely seen in collections of living wild animals and helps to show how universal is the working of the strange forces which prevent normal colour development. Above is a white elephant compared with a normal specimen. In Burma white elephants are the monopoly of the royal stables.

significant that these ferments are not obtainable from the skin of albinoes.

One theory is, therefore, that colour production depends upon the interaction of these ferments and chromogens and that albinoes lack the power of producing one or the other or both of them.

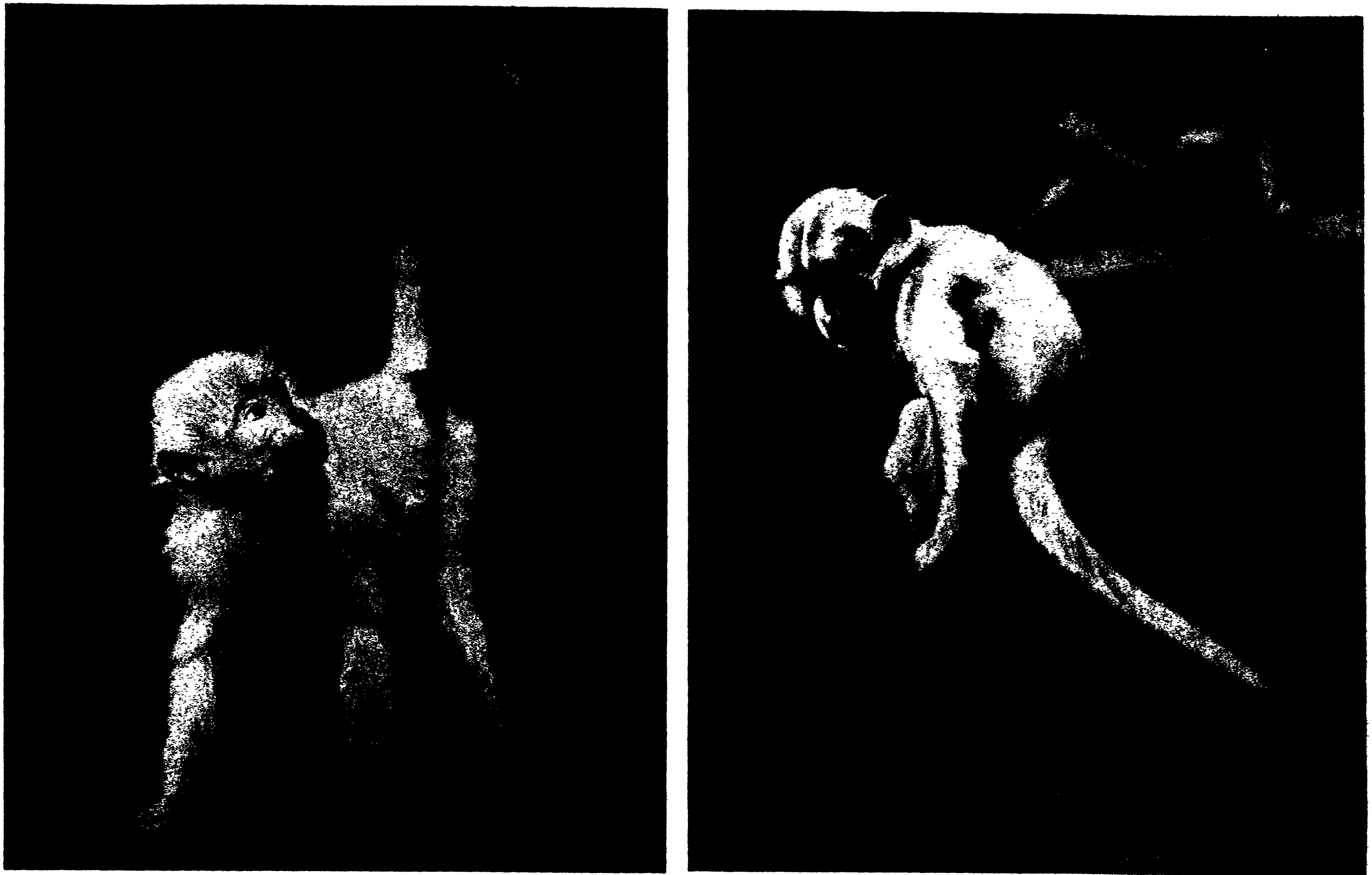
This theory accords remarkably well with the results of experiments on the inheritance of colour and albinism by animals and plants. Bateson's work with white sweet peas and stocks and many other experiments with animals, show that albinism, like colour, is inherited according to Mendelian principles and that it is reasonable to assume that in the chromosomes of animals definite factors or genes exist which represent the power of producing colour. It is further necessary in order to explain the results of breeding experiments, to assume that at least



Neville Kingston

LOBSTER WITHOUT COLOUR AND A PEACOCK WITHOUT ITS GLORY

Lobsters are ordinarily a very dark colour and almost black—the well-known bright pink being, of course, the result of boiling for human consumption. Here is a lobster though, which has no colour. We see it photographed through the water. Above is a white peacock (see also p. 510) walking with its colourless tail down. Although such a bird is generally called an "albino" peacock, this can hardly be a case of true albinism as the peacock's brilliance of colour depends not on pigment but on the structure of the feathers.



W. S. Berridge

Neville Kingston

TWO ALBINO MANGABEYS FROM THE TROPICAL FORESTS OF WESTERN AFRICA

Lack of colour in albinoes is particularly noticeable in the eyeballs The iris is colourless and the "white of the eye" is pink, because the blood vessels are not masked by pigment as in normal animals. Pinkness is noticeable in the skin for the same reason. Our photographs show two mangabeys, both albino specimens, the one on the left being called Jamrach's mangabey. The one on the right is known as the sooty mangabey, and the complete absence of its normal colour characteristics is therefore the more marked. The name of mangabey, incidentally, alludes to a district of Madagascar whence this kind of monkey, when first classified, was erroneously supposed to come.

W. S. Berridge

BARKING DEER THAT LACKS THE COLOURING OF ITS KIND

As the general colour of the muntjacs, or barking deer, is a rich golden bay an albino specimen is all the more striking. This little creature is only about two feet high and would be at a considerable disadvantage compared with its fellows since, being an albino, its eyes would be abnormally sensitive to the brilliant sunlight of India and Burma where it lives.

two such genes or factors exist without whose cooperation and interaction colour will not appear. These two genes are quite distinct and are inherited independently of each other. If only one of them be present in an animal's hereditary constitution, that animal will not develop colour. It is natural, therefore, to make the suggestion that these two genes represent the power of producing the above-mentioned ferments and chromogens respectively.

A true albino, on this Mendelian view, results from a sorting of its genes in such a way that it is left without either one or both of the genes whose cooperation is necessary to produce colour. It is thus that albinoes are produced in nature and by artificial selection controlled by man; and it is clear that, if this view be correct, albinoes cannot possibly produce colour so long as they are bred together. The only exception to this rule that albinoes breed true to their albinism, is the occasional occurrence among their offspring of reversions to the colour of remote ancestors which are similar to the reversions in respect to other characters which are familiar to those who are students of heredity.

We should expect, of course, that such a special sorting of genes or factors as this theory requires would be rare and we know that albinism is, in fact, a comparatively rare phenomenon. It is known in practically every group of animals and in many plants, but it has not become established in wild nature, both because of its rarity and because, as will be explained below, it gives place to colour when an albino mates with a coloured partner. The disadvantages attending total lack of pigment must also decrease the chances of the albino's survival.

THE importance of clearly distinguishing between true albinism and other kinds of whiteness becomes evident when we study the inheritance of albinism closely. We must remember then that local areas of white such as the white plumage of some breeds of poultry, the white patches on piebald negroes and on piebald and skewbald horses, are not examples of true albinism, because colour coexists with them. Further, some animals, such as the Himalayan rabbit, the cinnamon canary and the "Siamese" cat, are born colourless and subsequently acquire pigment slowly during their early life. But if we study only clear instances of true albinism we find that colour always predominates over it if it gets a chance to develop. Mendelian theorists express it by saying that albinism is always recessive to colour. This means that if we pair, say, an albino mouse with a coloured one, the first generation of offspring will contain no albinoes at all. The missing colour factor or factors have been introduced by the coloured parent and they have enabled colour to develop. But if we now pair with each other the individuals of this coloured first generation, we shall get albinoes again in Mendelian proportions, that is to say, one quarter of them will be albinoes, lacking the colour-producing factors, and these will, of course, breed true to albinism so long as they are mated together. They are what is called homozygous for the albinism character, which is a shorter and more precise way of saying that their chromosomes are without one or both of the colour-producing factors.

While we agree, however, that true albinism is normally recessive to colour, a fact which we should expect, as Bateson pointed out, from the frequency

W. S. Berridge

RECUMBENT RHEA WHOSE FEATHERS SHOW THE RESULTS OF ALBINISM

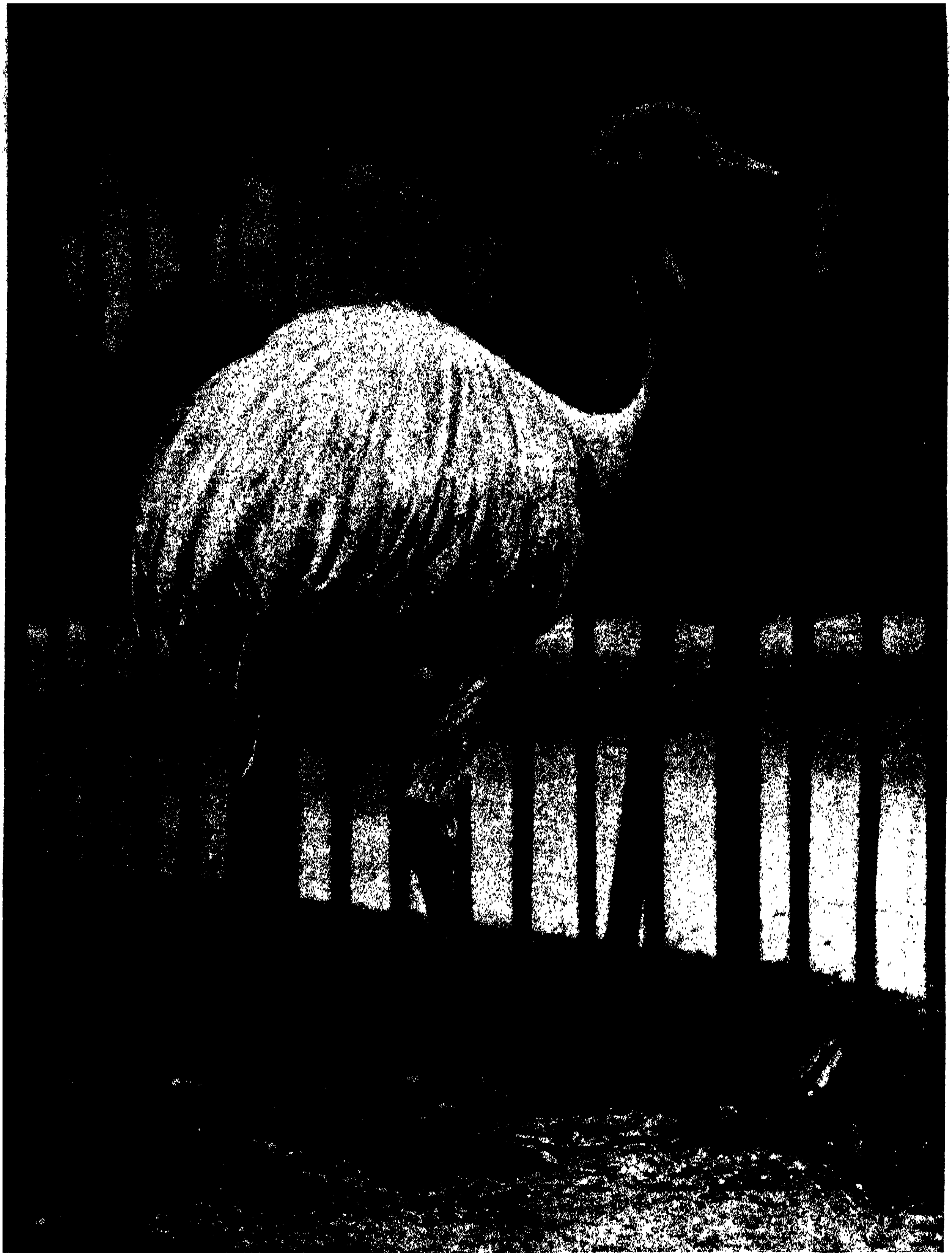
Experiments with animals and plants, especially with white sweet peas and stocks, go to show that both albinism and colour are inherited according to Mendelian principles. A real albino is the result of a lack of the colour-producing faculty and albinos can never produce coloured offspring if bred with albinos save in the case of an occasional " throw-back " to some remote ancestor, an accident that may occur in other departments of heredity than colour. But albinism is rare in wild life because its disadvantages prejudice the chance of survival.

of its occurrence among the offspring of nearly-related parents—human albinoes, for instance, being commoner among the descendants of cousins who have married—yet we must not neglect experiments made with animals that are not true albinoes. The white plumage of the white leghorn fowl, for instance, is dominant to coloured plumage, and experiments show that this dominance is due, not to lack of colour-producing factors in the hereditary make-up of the birds, but to the presence of another and separate factor or gene which somehow prevents the appearance of colour. Breeding experiments alone will distinguish between such a dominant white bird and a recessive white such as the white Wyandotte whose whiteness depends upon the lack of the colour-producing factors. We know very little as yet about such inhibiting factors, but, as Punnett suggests, they may be commoner than we suspect, and may inhibit the appearance of other characters as well as colour. The beardless wheat may be due to such a factor preventing the appearance of the beard.

To sum up this part of the matter, we can say that whiteness may result from at least two classes of genes in hereditary constitution. In the first class are animals which are partially white because their chromosomes contain a gene which inhibits the development of colour in certain parts of their bodies. This white may be dominant to colour and the white leghorn fowl is an example of it.

In the second class are animals which are white because their chromosomes lack one or both of the genes or factors on whose interaction the production of colour depends. These genes may represent the power to develop a ferment and a chromogen whose interaction produces pigment. The white due to their failure to cooperate is always recessive to colour, because, when a coloured mate is introduced, it brings with it whichever colour-producing gene is missing. Of this kind of white there may be three varieties: first, a variety lacking one of the two necessary genes, say the one representing the power to produce a ferment; second, a variety lacking the second of the two necessary genes, say the one representing the power to produce a chromogen; and third, a variety lacking both these genes. The actual existence of the third variety has not been proved by experiment.

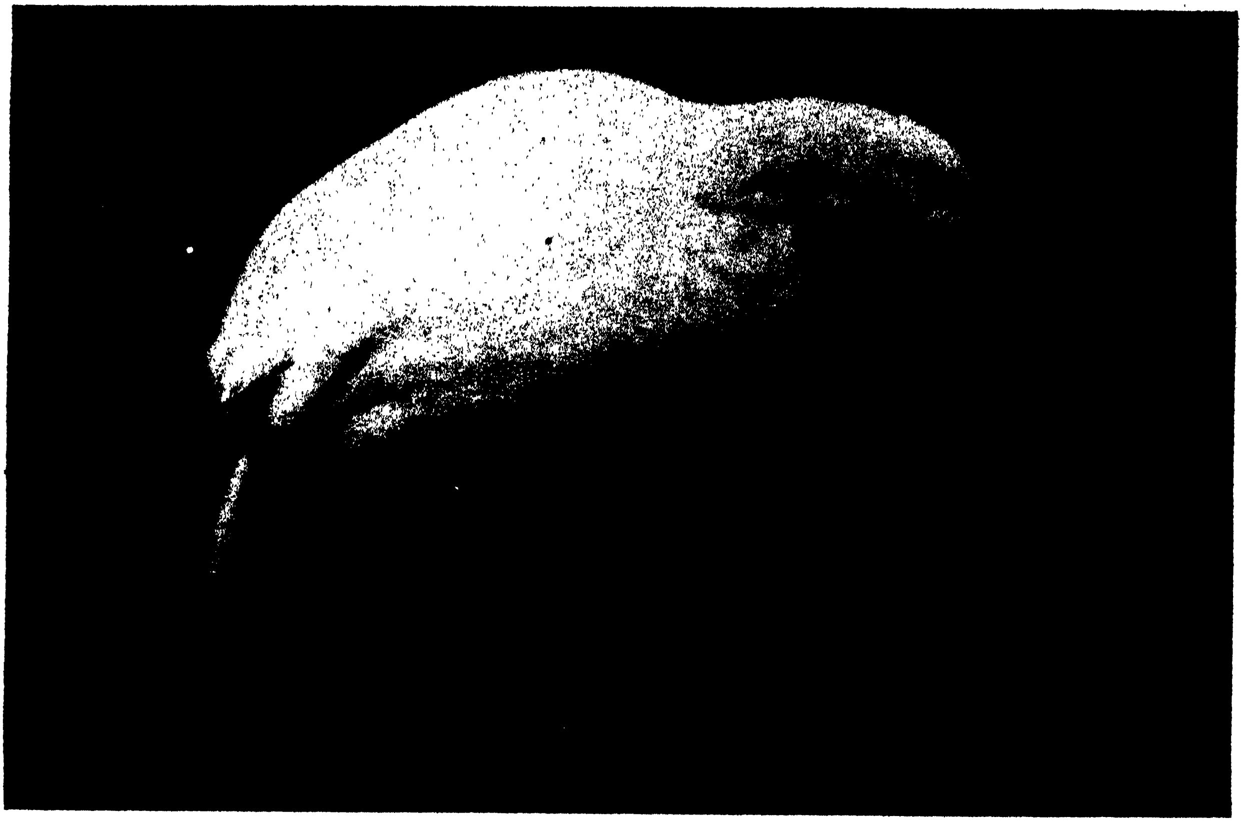
Certain other facts remain to be mentioned. We must not forget that although true albinoes are



Neville Kingston

ACTION OF ALBINISM ON THE FEATHERS OF A BIRD: A WHITE RHEA

Photographed with the camera inside its paddock this white rhea makes a fine picture standing against the bars. A bird so prolific as the rhea would naturally produce some albinoes every now and then. At one time as many as four hundred thousand of these birds are said to have been butchered every year for the sake of their feathers. Consequently the rhea is in danger of extinction, but the figures show how prodigious the rhea population used to be. This and the photograph in the opposite page show the effect of albinism on feathers.



Neville Kingston

WHITE WEKA-RAIL FROM NEW ZEALAND BESIDE A POOL

All the rails are water-loving birds and we see here a weka-rail by the margin of a pool. Ordinarily the weka-rail is brown and black in plumage, but this specimen lacks the tints characteristic of its kind. Experiments with birds that are white yet not true albinoes, such as certain white breeds of chicken, show that whiteness is dominant to coloured plumage, whereas if a normal bird breeds with a true albino none of the offspring will be albino. But if individuals of this offspring are paired, then a quarter of the resulting young ones will be albino.

without colour, they still can show the pattern on which colour would have appeared if it had been produced. Certain albino rats, for example, have longer and thinner hairs revealing the pink skin beneath them and arranged according to the colour pattern shown by their coloured relatives. In the same way the white tail feathers of an albino peacock (see picture on page 510), may show the eye-like markings of the coloured bird. We must conclude, therefore, that a separate gene exists for colour pattern and that this is inherited quite independently of the colour-producing factors.

FURTHER than this, Bateson's experiments with white stocks showed that no hairs were produced on these plants unless the flowers were coloured, which suggests a correlation between the factors controlling hairiness and those controlling colour-production. It is not unreasonable, therefore, to suggest that albinism may also be linked with factors controlling other characters, and such a conception is suggested by such evidence as exists that, in man and domesticated animals some degrees of albinism may be associated with lack of resistance to certain poisons.

We are not justified in asserting that albinoes are constitutionally weak, for in some respects they may be stronger than coloured forms. It is said, for instance, that white peaches in parts of America suffer less from the disease called "the yellows," and albino negroes are often taller and broader than normal negroes, although this may not imply greater vitality. On the other hand, albinoes show definite weaknesses in certain directions. The white pigs of Virginia cited by Darwin, whose bones turn pink and whose hooves fall off when they eat the roots of the paint-root plant which does not affect their coloured relatives, are an instance of this. When piebald cattle eat certain plants that cause inflammatory reactions in the skin, only the unpigmented patches are affected. Albino negroes, and even fair Europeans, are more susceptible to insect bites. The biochemists, indeed, may yet make very important discoveries about the part played by pigment, not only in the reactions of animals and plants to light, but in other new directions. While we understand so little the inheritance of colour and albinism itself, it would be premature to speculate about the inheritance of any weakness or strength that may be associated with either; but if albinism does prove to be linked with certain constitutional peculiarities, such linkages may prove to be analogous to the linkage of hairiness with colour mentioned above or to the peculiar mode of inheritance of such diseases of man as haemophilia and colour-blindness.

Chapter XCIII

The Minute Life in a Drop of Pond Water

By W. H. S. Cheavin

Corresponding Member of the Manchester Microscopical Society

An airman in his airplane flying at a low altitude over an unknown city for the first time and looking down upon the many forms of activity going on beneath him would be in the same position as an observer looking down the tube of a modern microscope at the many forms of life to be found in the various ponds, lakes and reservoirs.

The latter are fed by rain water which, passing through the ground and accumulating in quantities in the hollow depressions, dissolve out the many salts necessary for the conditions to give rise to the multitudinous forms of life which eventually appear during the course of time. Such water, examined under various modifications, drop by drop, will reveal a great variety of the many types of animal and plant life which consist of only one cell, minute in size, yet this simple cell can live, move, feed and reproduce in the water in which it lives.

The majority of these simple-celled animals belong to the large group known as Protozoa, which can be divided up into several sub-groups containing well-marked types, now to be considered.

The single cell in each case contains the fluid substance, found in all animals and plants, known as protoplasm, a very complex chemical body, the composition of which is still unknown. All animals, whether they consist of one cell or many cells, contain protoplasm in their cell contents, and the only difference to be found in this living substance is in its functions. It is very remarkable to find in the simple-celled animals so many characteristic properties and functions found in the individual specialised cells of the higher animals.

Let us now examine several animals belonging to the Rhizopodia (meaning thread-like rays), whose living matter enclosed in a single cell enables them to produce pseudopodia (false feet), blunt or finger-like in form.

A small, colourless, shapeless, transparent mass, which can assume almost every variety of shape by contraction and expansion, moving so slowly that we can hardly realize that it has changed its position, is the well-known Amoeba. This animal is the *simplest form of life, a most* important example because it stands at the base or foundation of all life and throws much light on the beginning of organic structure and vital activity, giving hints on the nature of the first forms of life of which we know nothing directly.

The amoeba is found in the mud of all ponds and consists of a unified corpuscle of living matter having a close relation to the blood stream of all mammals whose blood cells or corpuscles have the same movement, thus deriving the name of amoeboid cells. Further, many forms of life begin as an amoeboid cell; even man, who represents the highest form of life in the animal world, commences his career in this manner. The amoeba, consisting of a single-celled mass of protoplasm, shows a dark spherical body at its centre which is known as the nucleus and moves about with every movement of this simple animal.

The fluid cell substance, protoplasm, near the outer parts, is seen to be clearer and firmer than that found in the inner parts where it is more fluid and granular, consisting of protein and fat bodies.

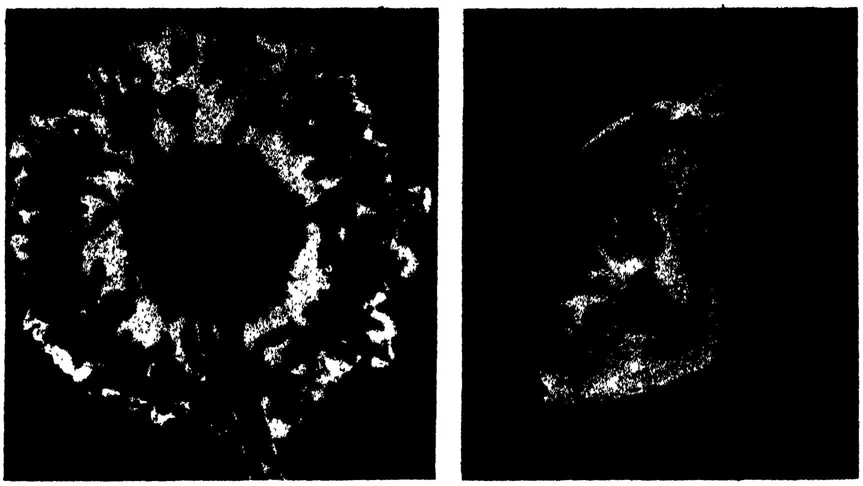
The protoplasm can be seen to move by a streaming motion in which the endoplasm from the inner parts passes outwards to the rind, where it becomes changed into ectoplasm and results in producing projections known as pseudopodia which in a similar manner by a reverse process can be withdrawn. New pseudopodia are thrust out at will from any part of the body in any direction. This movement is necessary for the locomotion of the animal, also to enable it to capture its food by flowing over its victim, generally a minute form of plant life known as the diatom. The diatom is engulfed and, as one writer terms the action, the amoeba unbuttons its waistcoat, the food is placed in contact with the body, and the waistcoat is buttoned up again which results in the food being absorbed. The disappearance of the diatom follows, and the waste products are rejected through an open space which eventually appears, and is known to science as the contractile vacuole.

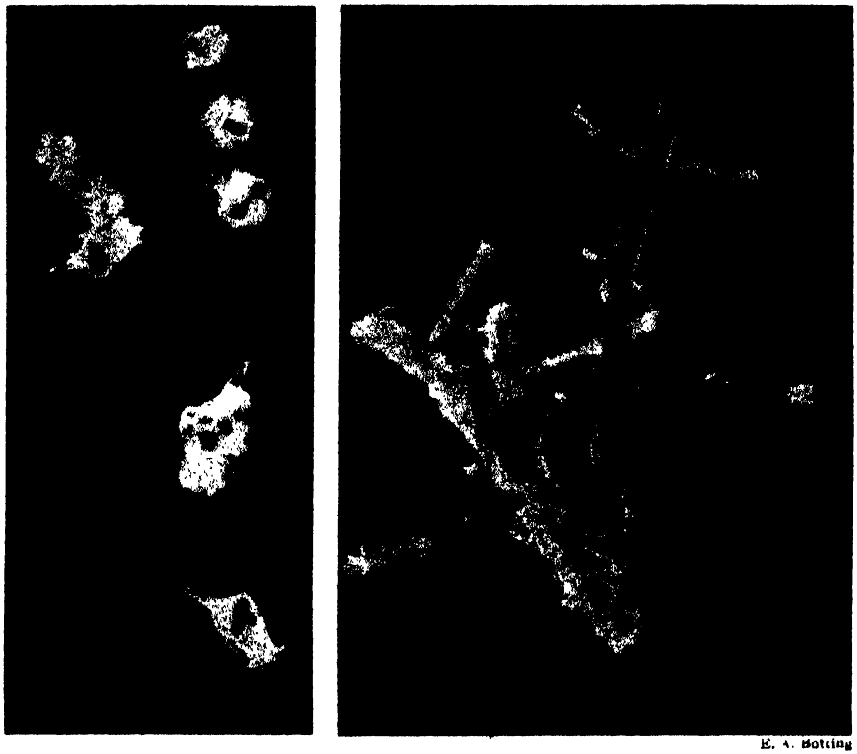
The changing of the protoplasm by this streaming movement is the result of surface tension phenomena enabling the amoeba, by

W. H. S. Heavin

GREEN GLOBES OF VOLVOX

Rolling through water go the green spheres of *Volvox globator which* comprise each a family of cells living together. The family moves by regular *strokes of cilia which* are like little lashes.





E. A. Botting

SOME OF THE MICROSCOPIC LIFE FOUND IN POND WATER

The rotifers, of which we have three examples in the two lower photographs, get their name from the wheel-like organs with which they are equipped. Here we have (left) specimens of Brachionus quadratus and a variety, rotundus, at a magnification of forty-five (x 45) and (right) Melicerta conifera which belongs to the order of rotifers called Rhizota, which means "the rooted." Above are a water flea (x 18, right) and a specimen of Lacinularia socialis (x 15).

forming pseudopodia, to move in a wavy path quite orderly and not at random, as is often stated. This wavy path, in the form of a helical spiral, is related to the movements of all free swimming organisms, such as flagellates, ciliates, and so on, and is due to an automatic regulating mechanism present in all organisms inherent in the same way as the property of growth. Every animal moves in a regular smooth spiral of one kind or another when free from stimulation, and no organism moves in a straight or irregular path.

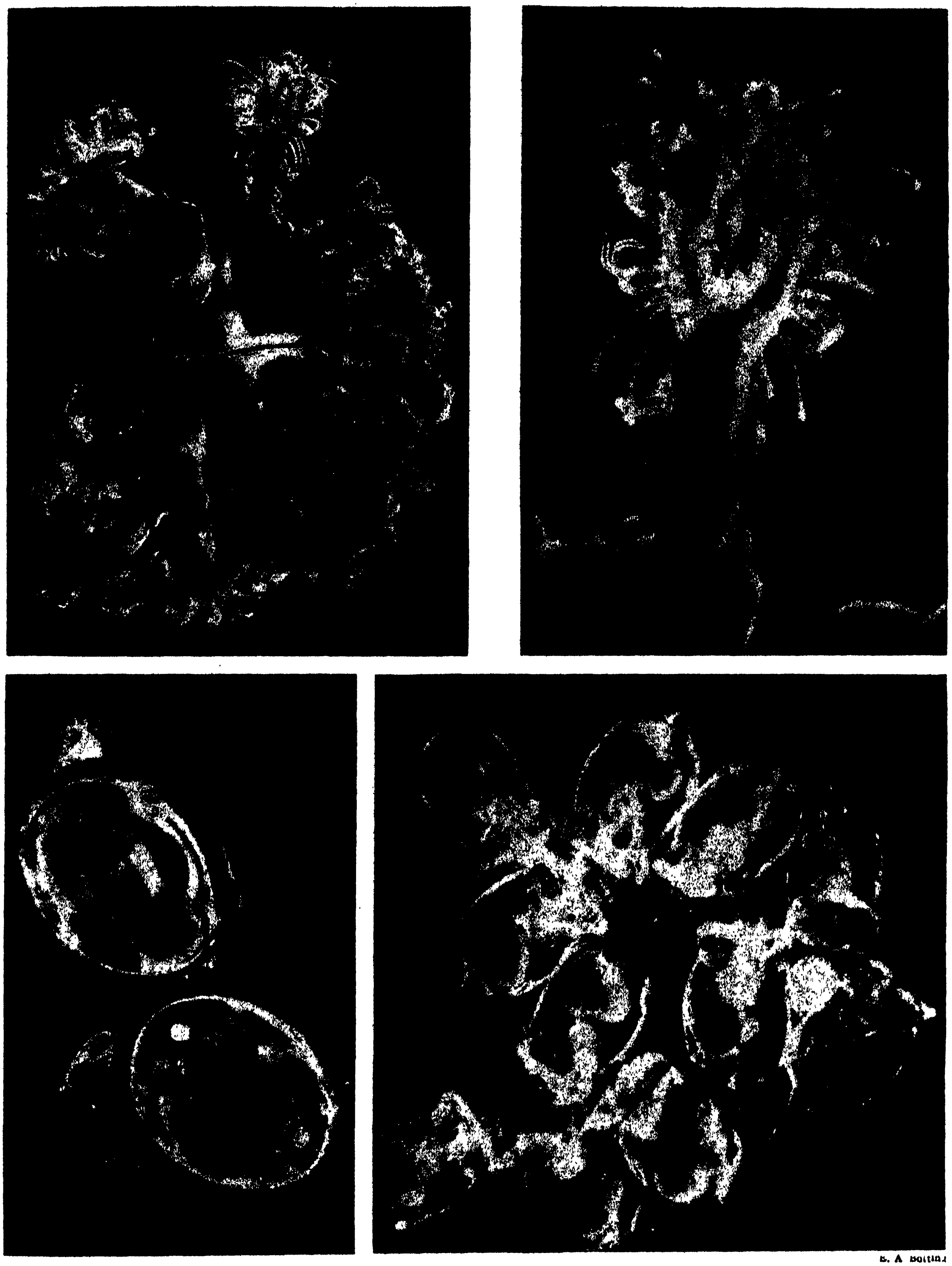
The amoeba and man are restricted to two dimensions in space, thus the amoeba in its habits and functions exhibits most of those found present in all animals to a greater or lesser degree.

The animal will soon perish when kept in water free from organisms which form its natural food, and even if these are replaced by chemical substances of a similar composition.

When under its natural conditions on attaining a certain size the amoeba will be seen to divide into two halves, each half containing part of the original nucleus ; this form of division is known as simple fission and is common to many forms of plant and animal life.

After a time this form of simple division comes to an end and two amoebae will be seen to approach each other, then fuse and surround themselves with a cyst or sheath ; after a time this cyst breaks down and minute spores are discharged into the water which gradually grow to the size of the original parents. If the pond dries up the amoeba at once encloses itself in a cyst and remains in this form in the dust produced from the mud when dried by the sun. The dust can be blown many miles, but wherever it goes, on becoming wet again in a new pool the encysted amoeba comes out of its protective layer and once more assumes its original life-history.

Owing to these facts, and experiments which showed that the animal can stand varying temperatures, it has been said that the amoeba is immortal. But this is not exactly the case, though by virtue of its simplicity it is in some measure exempt from natural death, which is the price paid for a body with its different kinds of cells performing different functions. There are many forms of amoeba which differ very much from each other ; a very low type known as Protamoeba shows no nucleus or contractile vacuole ; another type has a disc-shaped nucleus, and the animal can flow without change of form or pseudopodia ; whilst another type known as Pelomyxa contains many nuclei with refractile bodies.

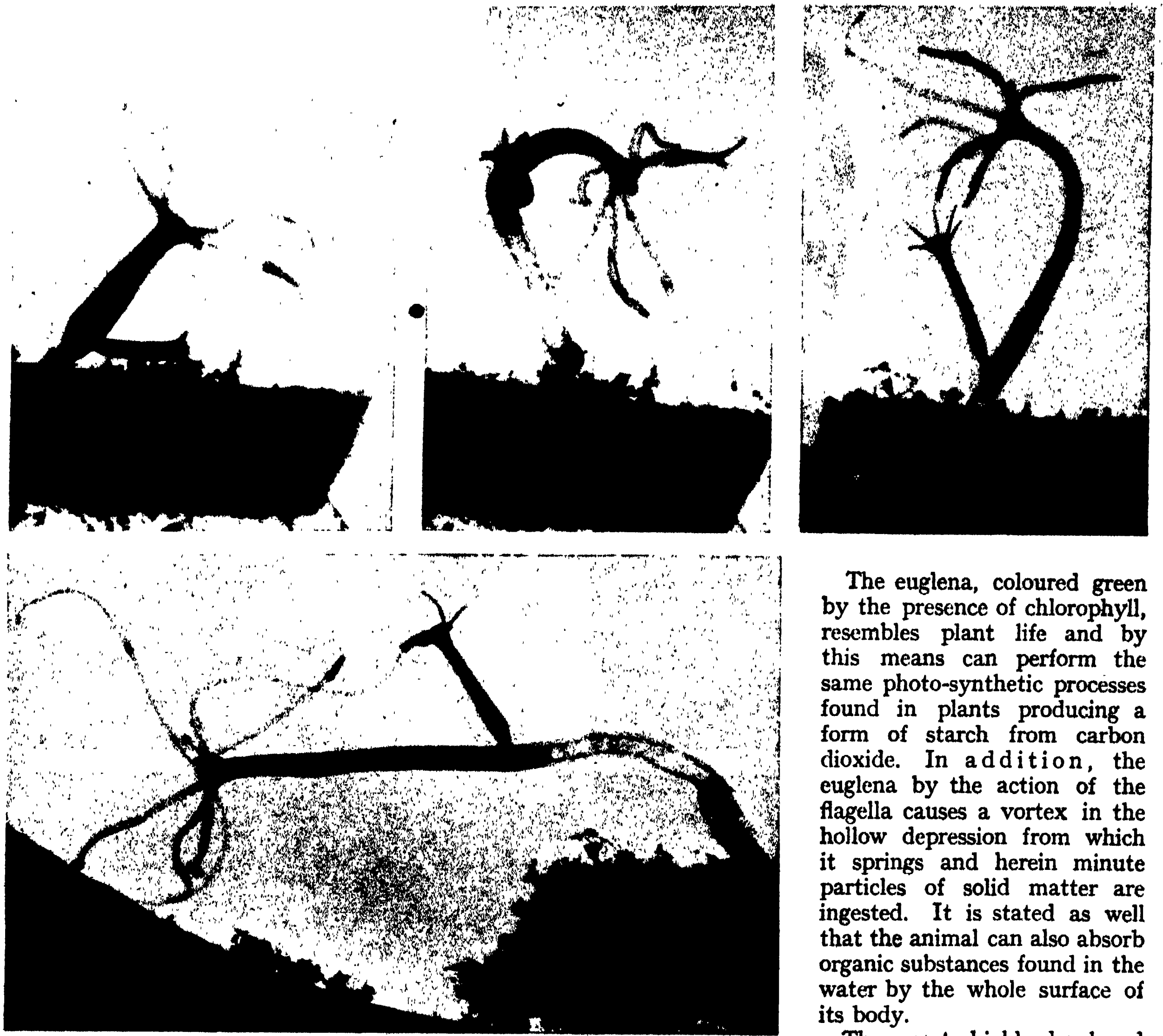


E. A. Botting

PARASITE OF WATER SNAIL: A ROTIFER, AND A MINUTE DWELLER ON POND WEED

wonder what [illegible] is the law of Nature. The answer is given in the bottom photograph, where [illegible] a magnification of forty (x 40). Here, also, are (bottom right) a specimen of a rotifer, Notops brachionus [illegible] crystallinus (x 20), one of the polyzoa found on pond weed; and (top right) an individual polyp of the same creature (x 50).

Minute Life in a Pond



E. A. Botting

HOW HYDRA VIRIDIS CHANGES ITS SHAPE AND POSITION

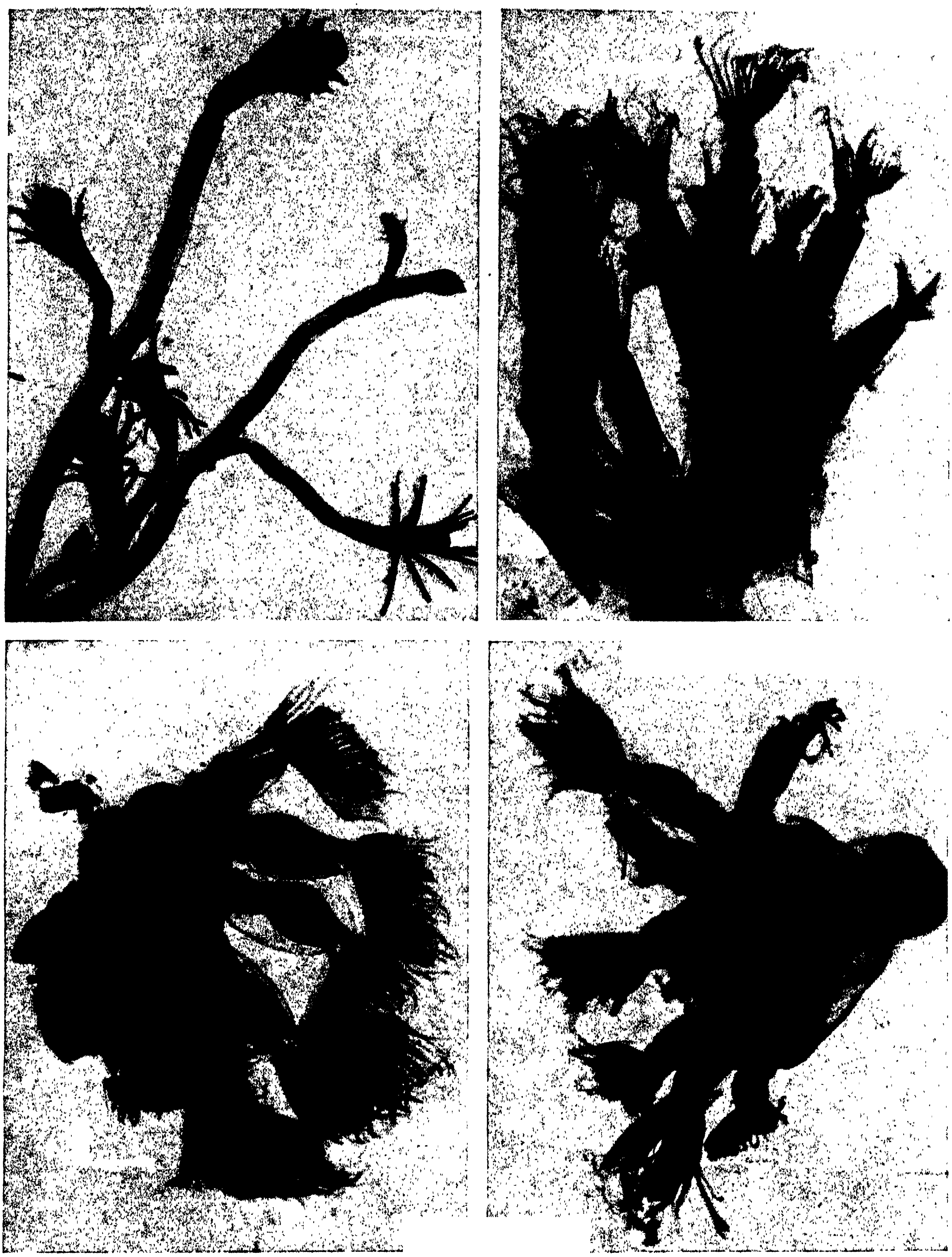
These photographs illustrate the power possessed by hydra viridis of changing both its shape and its position in a short time. The lower photograph was taken at a lesser power of magnification than the upper three. The hydra is seen attached to a fragment of reed and a young one is budding from the adult's side. Thirty seconds elapsed between the exposures.

Some Protozoa have a definite form and bear flagella or cilia and are known as Infusoria, the name given to all animals appearing in infusions of water containing organic matter and only visible with the aid of a microscope; this name was brought into use by the older microscopists of last century. A commoner type of infusoria bearing flagella, or whip-lashes, is seen in the Euglena, an animalcule of deep green colour making the water of the pond a dark green colour different from the lighter green of filamentous algae. The euglena swarm in large numbers and by lashing movements of their flagella propel themselves through the water at great speed. The flagellum is highly contractile and executes a number of rapid bending movements compared to a finger when beckoning.

The euglena, coloured green by the presence of chlorophyll, resembles plant life and by this means can perform the same photo-synthetic processes found in plants producing a form of starch from carbon dioxide. In addition, the euglena by the action of the flagella causes a vortex in the hollow depression from which it springs and herein minute particles of solid matter are ingested. It is stated as well that the animal can also absorb organic substances found in the water by the whole surface of its body.

The most highly-developed group of the Protozoa is found in a large number of one-celled organisms known as Ciliata, because on the body surface they bear many thread-like cilia; they have no power to form pseudopods and this is due to the fact that the body is enclosed in a pellicle, or cuticle.

A MEMBER of this group is seen in Paramoecium, which moves with great rapidity in a straight course with its blunt end foremost. It comes to a sudden stop, then turns and seems to hesitate, finally darting off in a new direction. The movements in this animal are caused by the fine hair-like processes which project from the body. These are seen to be pointed at one end, blunt at the other, and have a slipper-like form resulting in the name "slipper animalcule" being given to the creature. The body is enclosed in a pellicle having a groove leading to a mouth aperture; two nuclei are present, known as macro-



H. S. Cheavin

WONDERFUL COMMUNITIES OF MINUTE CREATURES LIVING IN FRESH WATER

The two lower photographs are of colonies of polyzoa; (left) one of cristatella (x 40) and (right) Lophopus crystallinus (x 40), showing each colony with terminal zooids. The top left-hand illustration is of cordylophora, and shows a typical polyp colony (x 40) with branches and scattered, filiform tentacles. Lastly, we have another and very remarkable example of a polyzoa community, that of plumatella (x 40) which can crawl about on plants as though it were a single individual instead of—as it really is—a large family.

nuclei and micronuclei respectively, which perform the functions of nutrition and reproduction. Two contractile vacuoles are present in different parts of the body, and each one will be seen to contract alternately with great regularity.

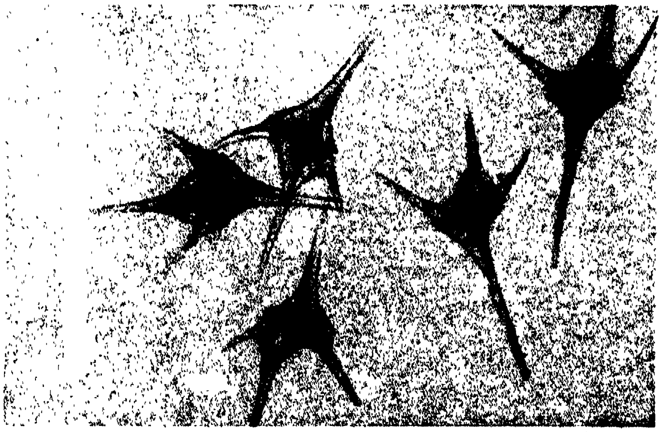
When well supplied with food the paramoecium multiplies by binary fission, which takes place two or three times every twenty-four hours for four or five days. The offspring become smaller and smaller, finally showing signs of decay. The animals then conjugate in couples becoming attached mouth to mouth which by fusion transfer nuclear material ; the two fused animals, diminished in size, then separate, commence to feed and so recover the original dimensions of the parent.

Closely allied to Paramoecium is Stylonychia, the mussel animalcule, but a more advanced type in having stiff bristles on its oval flat body and a funnel-shaped mouth having a ciliated margin leading to the inner part of the cell. There is a nucleus and contractile vacuole which contracts rhythmically ; by means of its cilia or seta this animal can set up whirlpools bringing food to the mouth ; it can also stalk along the stems of pond weeds or swim freely in the water.

Another conspicuous member of this group is seen in Stentor, the trumpet animalcule, found free-swimming or attached to the under sides of pond weeds ; it is constantly changing its shape from a small knob, when contracted, to a trumpet form when extended. Long cilia, which are seen on the upper part of the trumpet, lash about in the water and sweep food into the open mouth leading to the digestive sac. Here the food is used up and the waste products are excreted.

Adhering to the stems of water weeds will be found the beautiful Vorticella, or bell animalcule, because each resembles in shape that of a wineglass on a long stem ; this animal is one of the many numerous forms of ciliated infusoria living in large colonies, each animal leading a separate independent existence. When disturbed the vorticella will be seen immediately to retract its stalks or stems and the cilia present on the rim of the funnel-shaped mouth cease their lashing ; after a short interval the animal resumes its normal position, lashing the water vigorously with its cilia, which produce vortex currents and so convey food material into the funnel-shaped mouth.

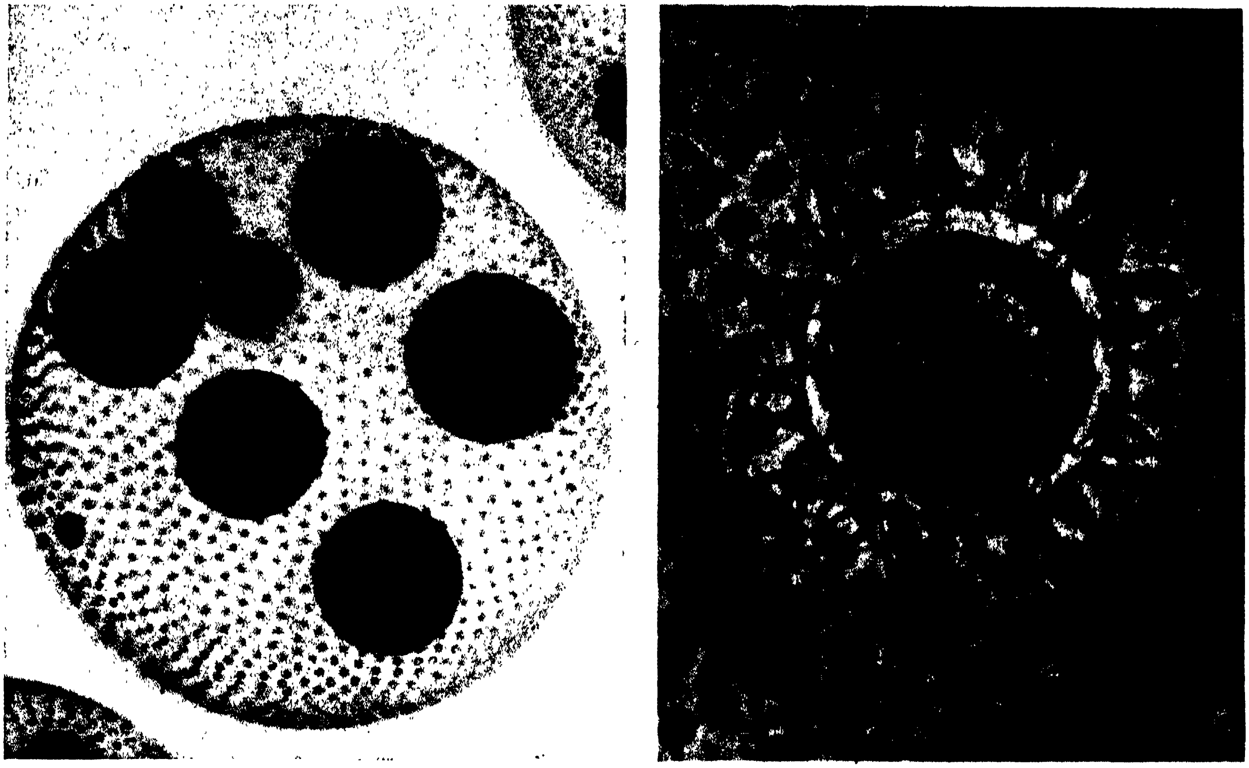
Vorticella reproduces itself by binary longitudinal fission dividing the body into halves, both of which become attached to



S. Chervin

MICRO-ORGANISMS THAT LIVE BY MEANS OF WHIPS

Ceratium longicorne (bottom ; x 200) is one of the many organisms which propel themselves by means of flagella, or whip-like appendages. Above is a specimen of the vorticella (x 403) or bell animalcule which lives on water weeds and looks rather like a wineglass with a long stem.



the same stalk. One half develops an additional ring of cilia at its point of attachment; then detaches itself from the stalk, swims away and in a short time attaches itself to a new position where it develops a new stalk and grows into a fully-formed vorticella. The other half of this division remains in its original position attached to the old stalk and this half may be looked upon as the parent and the half forming the new animal as the child.

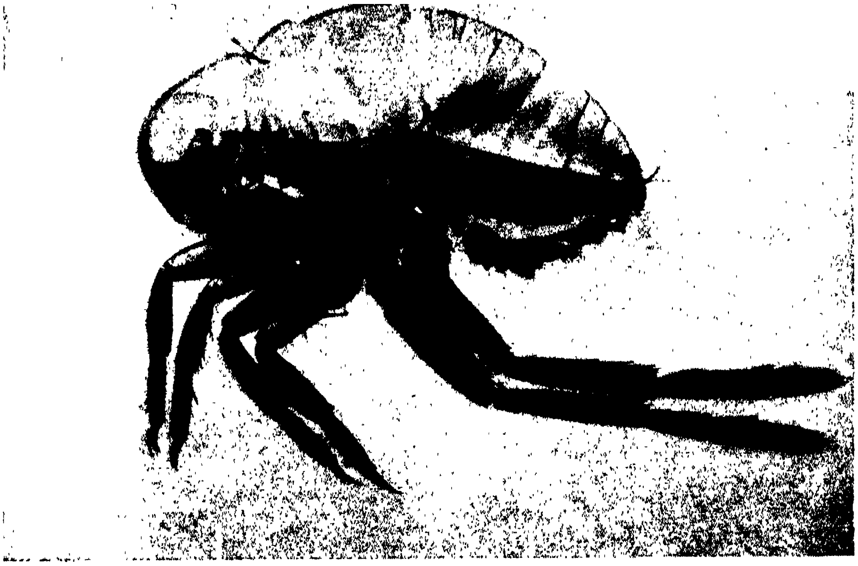
Another form of reproduction in vorticella can take place by the bell dividing into unequal halves; the lesser half may divide up again into as many as eight parts, each of which can develop an additional ring of cilia to enable the part to swim away and seek an exhausted vorticella with which it fuses at the base, becoming absorbed; this union results in a new period of life for the new animal thus formed, which then resumes the normal division for reproduction.

The Epistylis, or nodding bell animalcule, is another type of

H S Cheavin

COLONIES OF VORTICELLA AND VOLVOX AS THEY LIVE UNDER WATER

This (bottom) is how a colony of vorticella (x 186) looks on a fragment of pond weed when seen through a microscope. Above we see (left) a photograph of volvox globator (x 204) showing spherical daughter colonies in the mother envelope, which will eventually escape by breaking their way through; and (top right) a ripe oospore inside its mother (x 1116).



LARVA OF THE WATER BOATMAN AND ITS ADULT FORM

One of the most easily noticed creatures of the pond is the water boatman. Its body is like an inverted boat, the back being keeled and the ventral surface flat. This little pond hunter swims under the surface on its back, not on the surface like the water-skaters. The lower photograph shows the larval stage while above is the adult bug, both much magnified

colony-living animals which unite in a form of bush recognized from vorticella because the individuals have no contractile filament. When disturbed their heads drop down their short stalks. These animals though associated together on the same stalks have no organic connexion with each other ; they are found parasitic on cyclops.

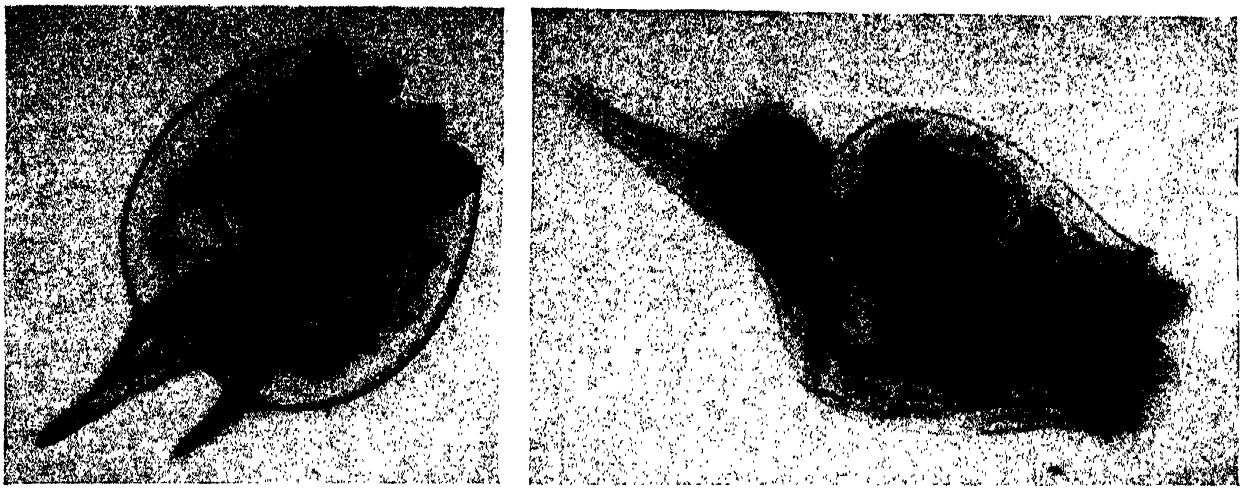
Another form of branching colony individuals is seen in Carchesium. A contractile filament in a stem is developed in each animal and they behave in the same manner as vorticella when disturbed. Carchesium differs in having a branched stem, each branch terminating in a bell-shaped body. When dividing not only the bell divides but also the stem, and the divided part remains attached to the parent stem. This form of division results in the course of time in the production of a large colony.

We now come to the Volvox globator, seen as a large number of rolling green globes propelled by regular strokes just as a boat is manned by a number of oarsmen. The motion is caused by cilia in pairs produced from the large numbers of individual cells which live together in the sphere as a family.

Volvox is usually placed by botanists amongst the lower forms of plant life, the Algae; but it can also be regarded as a type of Protozoa ; whether we adopt one classification or the other, we are faced with the fact that living organisms of the volvox type provide the connecting links between the lower forms of green algae and the flagellates having flagella of equal size, the protozoan group exhibiting a mixture of animal and vegetable characters. The green colour of the sphere is due to chlorophyll, the same substance found in all green plants and used by them to produce food material from the carbon dioxide of the air and from sunlight.

Volvox belongs to the group of plants consisting of a colony of cells united together by protoplasmic processes having ciliated cells on the exterior which produce motion by lashing the water in regular strokes. Plants of this family sometimes occur in prodigious quantity in water, giving it a pale-green colour and an unpleasant odour, while they are generally the cause of foulness in drinking water and produce a distinct oily taste.

One of the simpler types of the volvox family is to be seen in Pandorina morum, a spherical green ovoid cell consisting of sixteen or thirty-two individual cells having flagella whose united action enables the sphere to swim about. Every cell in this sphere can form a daughter colony which swells up the mother cell and later this breaks down, setting the young colonies free. In Volvox globator we have a large number of cells in the sphere which



E A Botting

TWO MEMBERS OF THE REMARKABLY ADAPTIVE FAMILY OF THE ROTIFERS

Distributed very widely owing to their powers of adaptation, the rotifers, to which family the above specimens belong, are most remarkable creations. They are found in both salt and fresh water, though more numerous in the latter. They can live alike in lakes, reservoirs and ditches, or in slow streams; in water-butts, roof-gutters, and wet grass; in the intestines of earthworms and slugs; and as parasites of volvox globator (see page 1033). The above photographs show (left) Noteus quadricornis (x 200) and Brachionus rotundus (x 200).

consists of some two hundred to twelve thousand cells enclosed in a thick membraneous envelope. These cells form a single layer and each cell body does not fill the envelope, being separated by a considerable space; the enveloping part pressed up against other enveloping parts has a hexagonal outline. Each cell has a nucleus, contractile vacuole, chromatophor, amylum body and a pair of flagella which give the colony its power of locomotion. These cells can reproduce by division, and so increase the number of units in the colony.

Reproduction is limited to a smaller number of cells of larger size having no flagella, and by means of binary division result in new spherical colonies formed in the mother envelope, where they fall into the central cavity, first developing flagella; after a while the colony escapes by rupture of the maternal wall.

LATER a new type of colony begins to form, differing from the previous colonies in having a larger number of non-flagellate cells; these new colonies increase in size, become deep green in colour and fall into the central cavity of the mother cell; these cells are ova, becoming fertilised later by another type of flagellated cell formed in the same way as the ova cells. A fertilised ovum results which surrounds itself with a double cyst wall provided with spines and projections; this is a zygote, or spore, which can survive the winter and later, in spring, develops by repeated cell division into a volvox colony.

Volvox is the culminating point of mobile spherical forms, and though its individual cells are of a primitive type the entire organism, owing to the differentiation of its compound cells, shows that it is a summary of the evolution of sex, and suggests the successive steps through which unicellular organisms gave rise to the multicellular and—belonging to neither or either the animal or vegetable kingdom, but equally to both—brings us face to face with the unity of nature, a most important point in the wonderful theory of evolution.

In fresh water, especially from some reservoirs and lakes, tiny spherical masses are observed covered with a protective layer of spines, or spicules; these spherical masses are statoblasts, or gemmules of the common fresh-water sponge, two types of which are found in Britain, though the majority of the Porifera, or canal-bearing zoophytes, constituting the sponge family, are found in the sea. The gemmules of the fresh-water type are produced by the adult sponge in the autumn when food is scarce and the colder weather begins to set in. The parent then dies away, the gemmules, surrounded with a horny shell and strengthened with siliceous spicules, survive and in the spring float away from the dead parent, developing by bursting out from the interior into new sponges, thus having served two purposes, one of protection and the other of dispersion.

The adult sponges are green in colour and generally found attached to some object in the water, branches of trees, stones, etc. Fresh-water sponges are a source of trouble in waterworks and have been found to block up pipes owing to their dislike of mud, which clogs up their pores.

Let us now examine a few examples of the larger types of animals found in ponds, lakes, etc., which can be held in larger drops of water than those described in the former types.

These are radially symmetric, having one body cavity which serves alike for digestion and circulation and include in the large group Coelonterata, polyps, corals and sea-anemones. Reproduction is effected by budding from the body of the parent or by formation of a fertilised egg, both giving rise to an entirely new individual.

The green Hydra viridis, fixed by its base to aquatic plants, is a solitary animal consisting of a long, two-layered body surmounted by a crown of several hollow tentacles seen to be waving about in the water; the animal can also lift itself up by the tentacles, stand on its head or creep by looping movements. If disturbed the animal retracts the tentacles, contracts its body and forms a small mass which eventually, when its alarm is over, once more expands and resumes its activities.

The hydra feeds on small animals such as daphnids, or water fleas, which on coming into contact with the tentacles become paralysed. The tentacles bend and convey the victim to the opening or mouth, where it passes into the body cavity to be digested, the unwanted portions being expelled through the same opening; the whole procedure being possible of observation through a microscope. The hydra can be cut into several pieces, each piece growing into an entire animal. These fragments must be a fair sample of the body to produce this effect; further, the animal has been turned inside out, which gave the impression that all the cells, inner and outer, were of the same kind, but this, of course, is wrong, for it was found that the animal after a time reversed the process, or if prevented, the cells by growth restored the animal to its normal condition. The usual method of reproduction is by budding, which is first seen as a bulge in the body of the parent on the outside. This first forms two tentacles, and more are developed later when the bud has broken off and floated away in the water to carry on a free existence of its own.

A sexual method of reproduction takes place in the autumn season, when male organs are produced below the bases of the tentacles, and lower down still the female organs; the two kinds of reproductive cells may form on separate animals. The male organs become expelled into the water and, on reaching the female organs, bring about fertilisation, forming the eggs Later these eggs fall away from the parent and remain in the bottom of the pond in a quiescent condition till the spring, when they produce young animals which then carry on once more the life-history of their progenitors.

Closely related to the hydra, which is a solitary animal form, are colonial forms belonging to the great group of polyps which produce a complicated type of bud setting free a medusa, and this develops generative cells distributing its products far and wide; the sexes are always separate, and when they meet unite to form the egg, developing the larval form, which swims to the bottom, attaches itself, and grows into a new polyp colony. The greater number of these polyp animals live in the sea, but in fresh water we find one example, Cordylophora, which becomes a nuisance in waterworks by growing rapidly, choking up the pipes at all times of the year.

Floating in the water of a pond will be found seed-like bodies, or the statoblasts of the polyzoa, small animals growing together united into colonies formed of polyp-like organisms, which present a superficial resemblance to colonies of hydroids.

The free-floating statoblasts are the summer forms, differing from the fixed forms produced in the autumn, which remain at the base of the colony when the parent colony has died down, and in the spring open out like a watch-case. The individual then emerges to start a new colony. The full-grown animal is found attached on the underside of water-plants as a jelly-like mass which, under observation, will be seen to expand into a number of erect tubes surmounted by crowns of tentacles which can be retracted or protruded by special muscles traversing the body cavity. The mouth is present in the midst of the circle of ciliated tentacles, and the disk bearing them is known as the lophophore, serving both for procuring food by whirlpools in the water and as a means of respiration. The digestive organs are in the body cavity, containing an alimentary canal and a simple form of nervous system.

Reproduction is effected by the two forms of statoblasts which are really a form of bud; in some forms, such as Cristatella and Lophopus, parts of the animal can separate off from the colony and divide spontaneously, also the former type can crawl over objects in the pond as if it was a single individual instead of being a colony.

The polyzoa are mostly marine, and found between tide marks or on the floor of the ocean, but some types are found in fresh water, whilst others are phosphorescent and others excavate passages in shells of molluscs. The statoblasts facilitate the distribution of the species and can become attached to the legs, webbed feet, or other parts of water birds, and so are carried long distances over the earth's surface.

Pond water may also contain examples of higher forms of animal life known as Crustacea, which have their body with a hard external skeleton known as the carapace, or shield, the body segments carrying antennae, or feelers and jointed legs.

A common form of this class is found in the active, free-swimming cyclops, so called because of the single eye seen in the middle of the head; the animal, when swimming, is pear-shaped in outline, broad in front, tapering behind; the abdomen ends in a caudal fork consisting of two lateral processes bearing a large number of setae; in the female the eggs are carried in a couple of ova sacs attached to the last segment of the thorax; the females largely outnumber the males, and are so prolific that they can produce many millions of young. When hatched they appear in the form of an oval Nauplius, which, passing through several moults, acquires the adult form. Five pairs of feet are present, four pairs being used for swimming, and in this action the cyclops swims upside down.

Another common form of the Crustacea found in pond water is the common water flea Daphnia pulex, so called because of its jerky movements when propelling itself through the water. The body is enclosed in a transparent bivalve shell, through which we can see the whole of the organs.

Chapter XCIV

The Wonderful Wanderings of Animals

Dr. Marion Newbigin

Author of "Animal Geography"

As the seasons come and go the noontide sun swings up and down in the sky, its rhythm punctuating that of all living creatures. With us its upward climb in spring means that buds unfold, and the seedlings which have been lying dormant within their hard coats are stirred to a new life. Once Midsummer Day has passed and the downward movement begins, there is a notable check to the rush of growth, and the first frosts of autumn find the plant world already prepared for the long period of rest.

Even in the inter-tropical belt, where the noon rays never deviate far from the vertical, and average temperatures are always high, the sun tends to carry with him in his swing a cloud mantle. Thus the moisture, which is as necessary as warmth to living things, increases as the vertical sun draws near, and diminishes as it retreats. Again, therefore, there is a rhythmic change, though the beats are far less marked. Finally, in Polar regions the long summer days, during some at least of which the sun never sinks below the horizon, mean that green plants can carry on those vital processes which depend upon light with a continuity which goes far to make up for the slowing down due to the slant of the rays and the resultant low temperatures.

Here then the beats are accentuated, the alternation between the cold dark winter and the short bright summer being very sharply marked. Everywhere, that is to say if plant life is possible at all, it shows to a greater or less degree seasonal variation, this being least marked in low latitudes and most marked in higher. The plants of necessity can but wait till the earth's revolution brings the sun back to them. But many animals have great powers of locomotion, and can use these to "follow the sun." Migration in the strict sense is the name given to such movements, which are one form of response to the changing seasons.

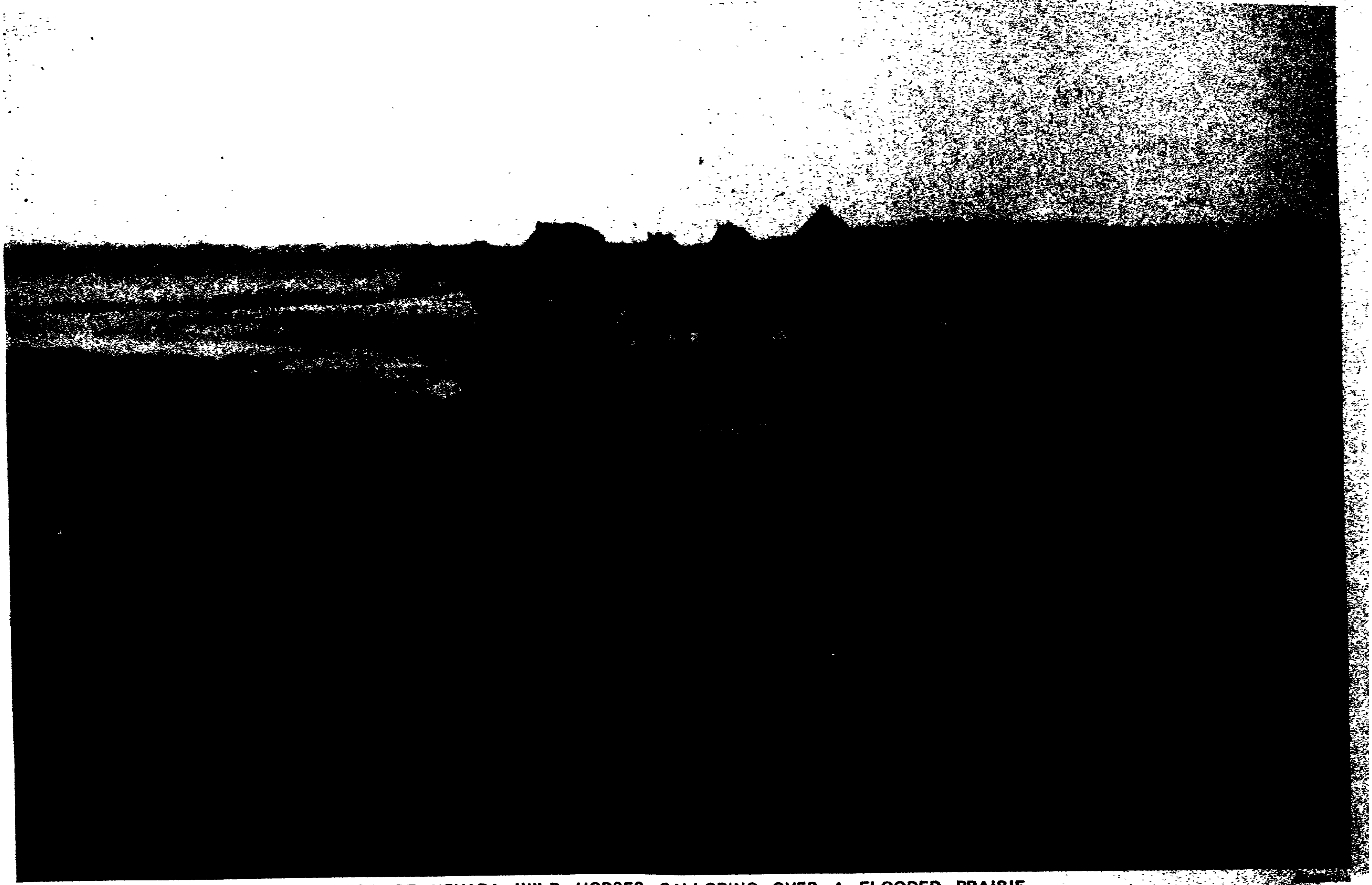
W. S. Berridge

FIELDFARE, A WANDERER OVER EUROPE

Breeding in northern Europe, the fieldfare comes south in winter to find unfrozen ground whence it can obtain the snails and worms on which it feeds. England is a favourite resort, and the birds usually return to the same locality year after year.

Two main types of migration can be recognized, even if in practice the distinction is not always sharp. Most large grass-eating mammals live in flocks which require much food at all times, and soon exhaust the herbage of a particular spot. Such animals are necessarily wanderers, and to the daily and local movements, determined not only by the search for good feeding-grounds but by other causes, such as the need for water, for shelter from large beasts of prey or from insect pests, and so on, there must be added large-range movements made necessary by the passage of the seasons. These may be horizontal or vertical; for it is a commonplace that high mountain ranges display the climates and vegetation of different zones of latitude as one ascends from the base to the crests. The caribou of Northern Canada move northward in summer as growth begins in the Barren Grounds, and southwards, often in great bands, to the forest edge or even into the forest itself, in autumn as the Polar snow-cap extends gradually over the lands. As spring creeps slowly up the great mountain chains of the world, melting more and more of the snow, exposing more and more of the resting plants to the sun's beneficent rays, various kinds of herbivores follow in its train.

Such migrations of wild herbivores are always tending to be replaced by those of domesticated or semi-domesticated flocks and herds, where the movements are controlled and regulated by the herdsmen. Examples are thus now relatively few, though there is a good deal of evidence to show that they once occurred on a very large scale. The bison of North America, for instance, now virtually extinct as a wild animal, seems to have formerly migrated through a wide range of latitude. But though the phenomenon is often imposing, both on account of the distance traversed, and the great numbers involved its causation is relatively simple, and little of the nature of a special instinct need be assumed to account for it. In particular it should be noted that as a rule the area traversed is throughout suited to the animals, which feed on the march. The movements are a continuation of the ordinary short-range ones, the initial cause being the need for finding



HERD OF NEVADA WILD HORSES GALLOPING OVER A FLOODED PRAIRIE

Fast-moving animals like the horse can " follow the sun " as the influence of its distance or nearness comes to bear upon the supply of vegetable food. The scene captured by this photograph reminds us of the days when vast herds of wild horses used to inhabit the vast plains of Europe and Asia as a remnant still does in Mongolia. As the seasons change and the food supply shifts from south to north and back again, such animals, living in large communities and needing great quantities of food, must change their feeding grounds accordingly. The mustangs seen here are not true wild horses, but the descendants of domestic individuals that took to the wild. They make a fine sight as they splash their way over a flooded prairie.

W. S. Berridge

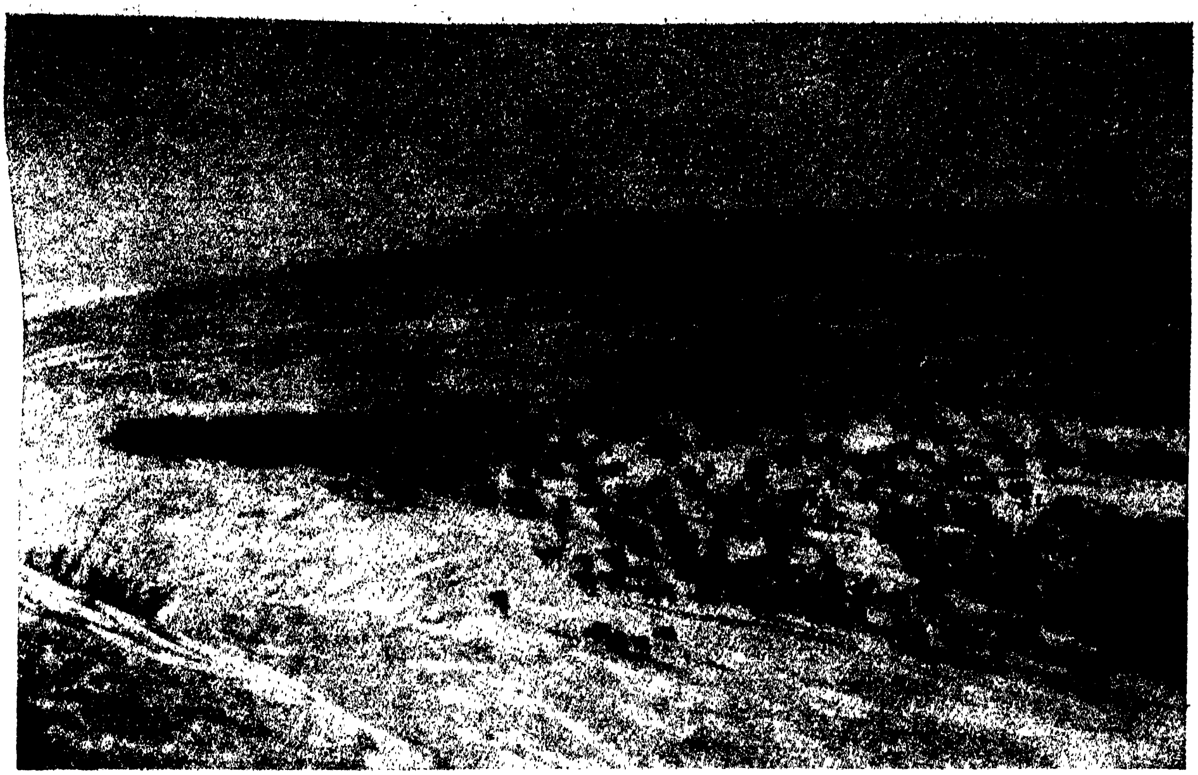
ONE OF THE AMAZING WANDERERS WHOSE JOURNEYS END IN DEATH

Of all the animals which are famous for their wanderings the Norwegian lemming has most appealed to popular interest on account of the extraordinary tales told of its migratory habits. In Norway, where arms of the sea continually split the coastline, the onward march of the lemmings is sometimes only stayed by the ocean itself. These little rodents, which inhabit northern Asia and Europe, increase locally, every now and then, until the food supply is inadequate and migration must take place. Few of the wanderers ever return.

suitable food. Indications of an approaching change of weather, to which many animals are very susceptible, may start a movement on a greater scale than usual, and local variations in relief may make it necessary to pass rapidly from one feeding-ground to another some distance away. But in the general case the migration is probably leisurely, and not a sudden passage from one zone to another.

Again, in all such cases the animals breed at a time when pasture is most abundant and richest in foodstuffs, and the young, though fed at first on the mother's milk, the flow of which is stimulated by the lush grass, soon learn to nibble at her side. Thus conditions favourable to the mature forms favour the young also. This is generally true of mammals, particularly land mammals. Just because young mammals are fed for a longer or shorter period on the mother's milk they are, as it were, largely independent of their natural surroundings for some time after birth, as they are also during the often prolonged period of gestation. With birds, reptiles, fishes, insects and many other kinds of animals it is otherwise. The eggs which are laid may require certain special conditions before hatching can take place, conditions not necessarily the same as those which best suit the adult out of the breeding season. Further, the young forms on hatching may be quite unlike the parents; they may require to be fed by the adults, as occurs with almost all birds; they may need food of a kind not taken by the adults, when it is a necessity for survival that hatching should take place in a suitable medium. Thus a second great type of migration is one whose purpose it is to ensure the well-being of the young. This is often much more complex and difficult to explain. Once their parental duties are over the adults may return to the point from which they started, either to repeat the process in a new season, or, as happens with some kinds of salmon, eels and many insects, death may follow at the end of the single migratory movement, and it is the young only which ever return.

Both these types of migration are regular, to-and-fro movements, whether they affect the individuals, as with birds, or the generations, as with some fish, and appear as automatic as the motions of the earth, which seem to be their stimulus. The suggestion that it is the movements of the earth which induce some members of the salmon family to migrate from salt water to fresh to spawn; the eels to reverse the process and move from fresh water to salt; and

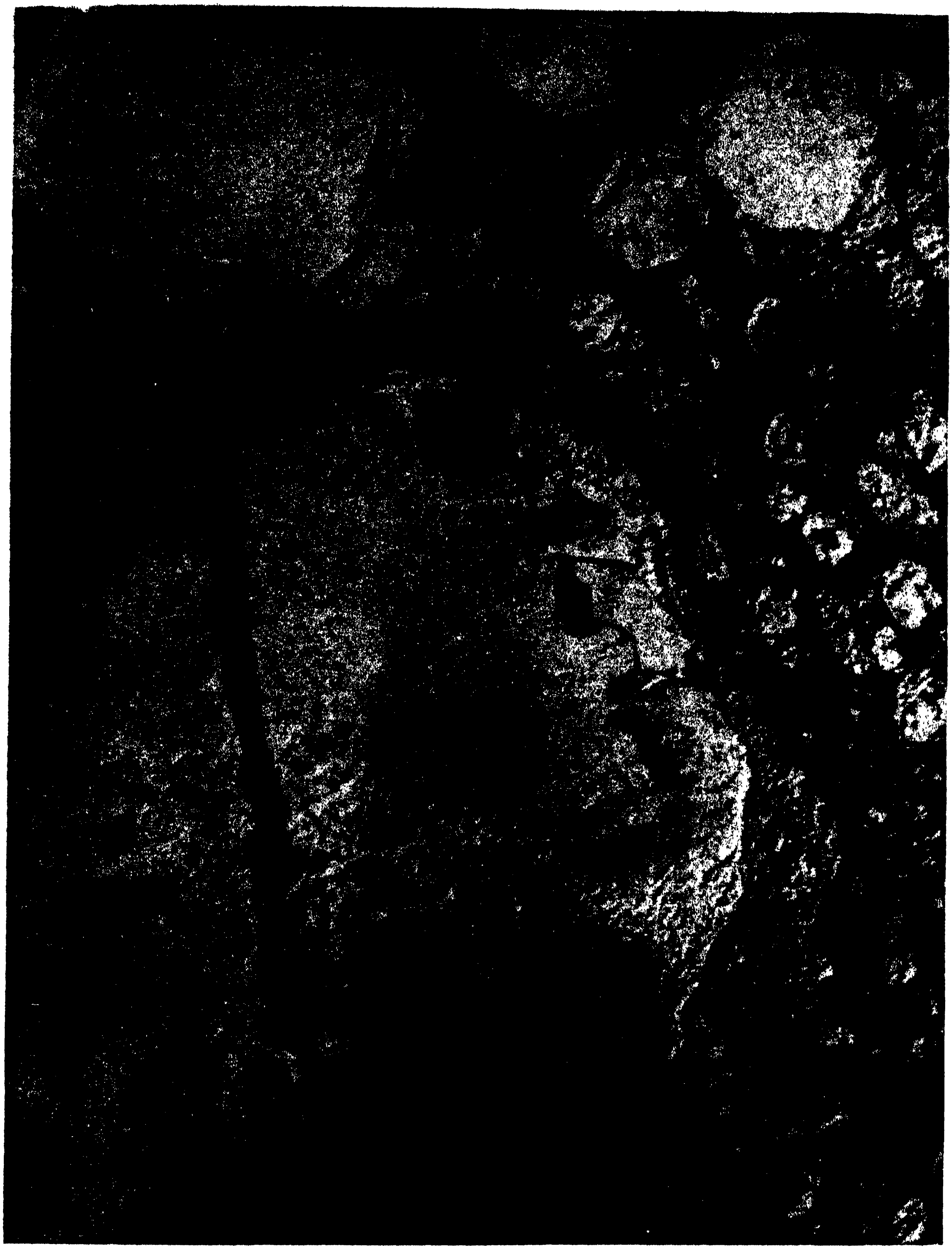


E.N.A.

Mondiale

NORWEGIAN AND ALASKAN REINDEER THAT MAKE GREAT SEASONAL MIGRATIONS

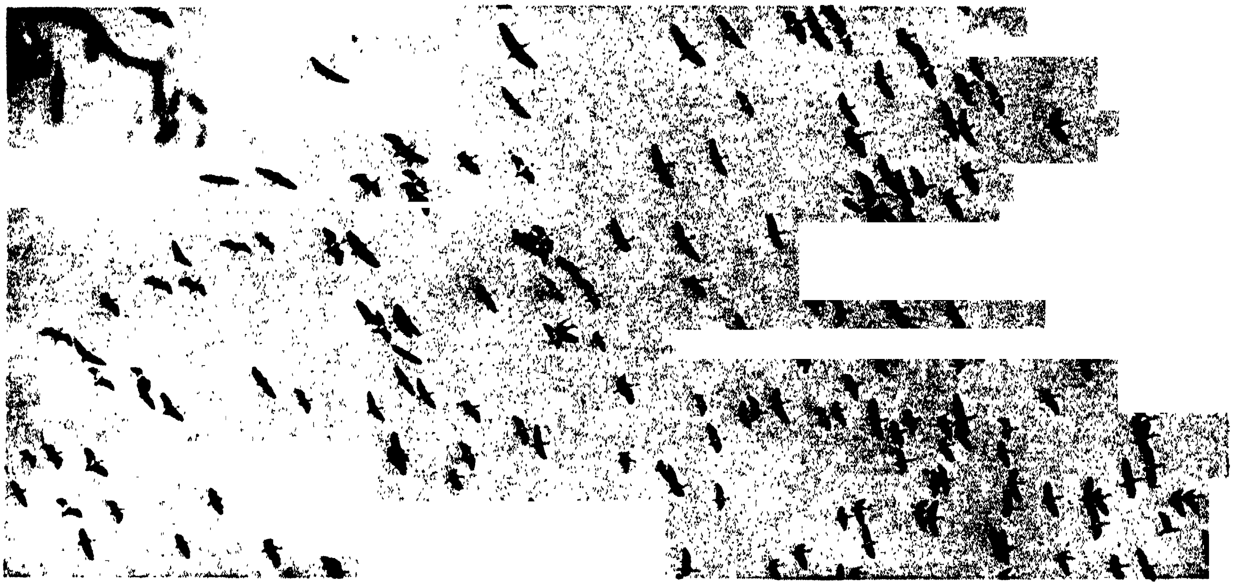
Large herbivores of northern or sub-Arctic regions tend to follow the movements of the snowline. The reindeer still make great marches from one season's feeding ground to another. In Scandinavia the herds are becoming domesticated and their movements controlled, to some extent, by herdsmen. The lower photograph shows a herd of Norwegian reindeer. They are fine swimmers and, when on the southward march in winter, often swim off from the mainland to the islands for food. Above are some Alaskan reindeer.



Planet News Ltd.

HOW A SEAL HERD LOOKS FROM AN AEROPLANE FLYING OVER THE FROZEN SEA

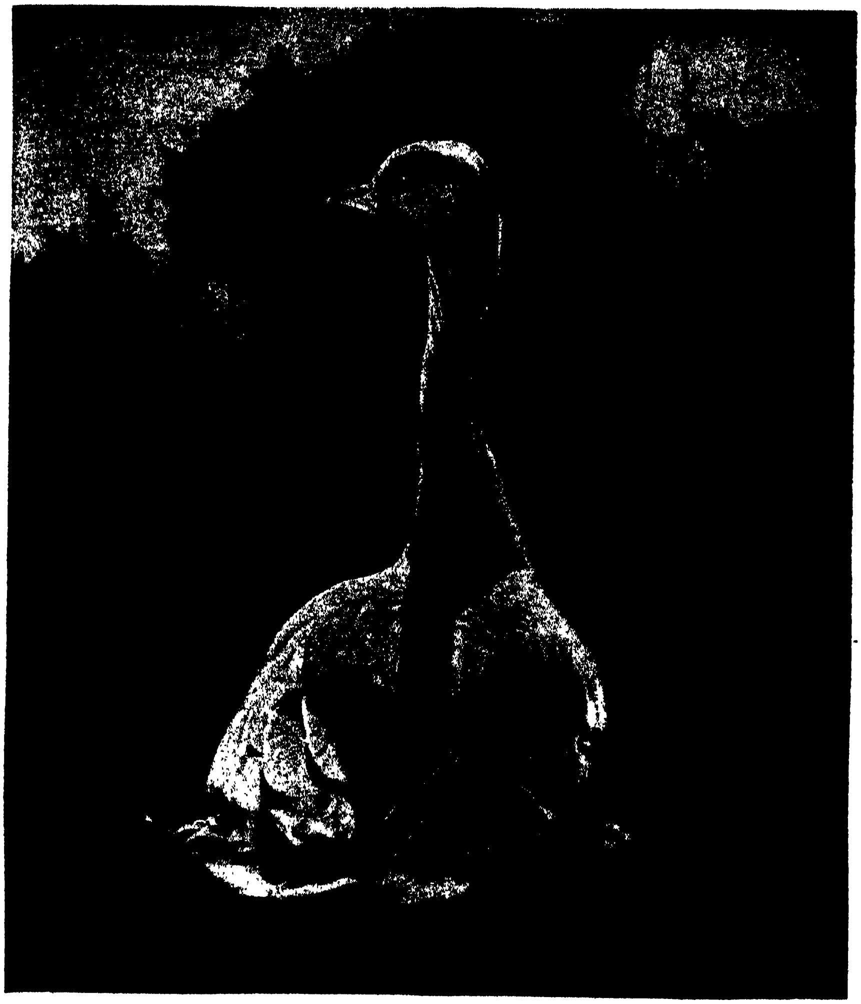
To realize the size of a seal herd it is necessary to be up in an aeroplane. This does not disturb the animals and allows, of course, a very wide view of the surrounding floes. The wonderful photograph which we have here was taken by an aeroplane employed by a sealing expedition. To save much time in locating the herd the aircraft was sent up and, covering an enormous distance in a short time, compared to a ship, sent the whereabouts of the seals to the sealers by wireless. Such methods seem to presage the seal's extinction.



Frank Rink

attention because of their destructiveness, and because the dead or dying stragglers may pollute water supplies and in other ways affect human life. Other cases of the same phenomenon are less noticed because these elements are absent. For example, the painted Lady butterfly is as a rule rare in England. But in certain years, particularly if favourable winds prevail at certain times, great swarms cross the Straits of Dover, and the butterfly becomes locally very common.

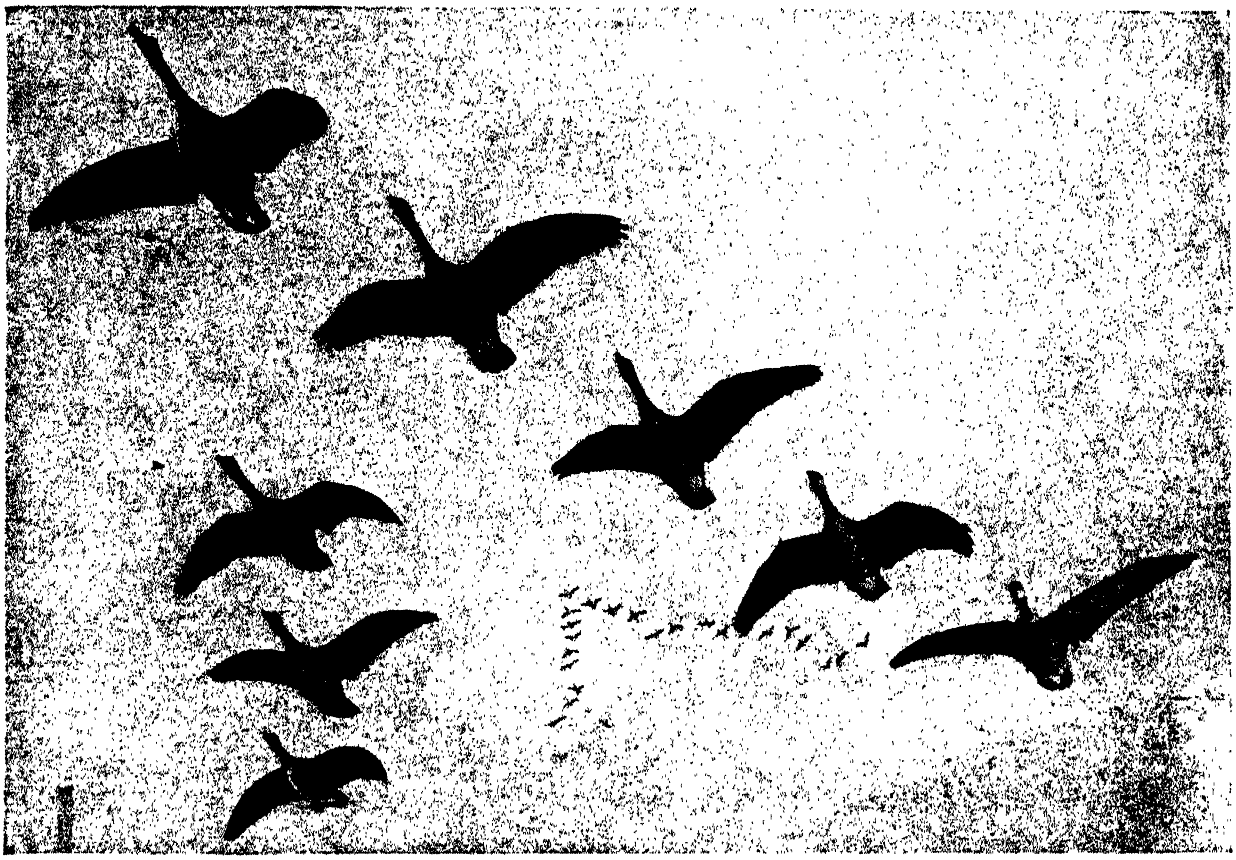
The immediate cause of such sporadic increases in numbers of certain kinds of animals is probably those marked non-periodic variations in climate which are known to occur in many parts of the earth. But the outward movement, from one standpoint, is but an illustration of the general tendency of organisms to spread over the earth, a tendency kept in check under normal circumstances by the struggle for existence. In the case of the lemmings it seems to be established that the swarming neither results in a permanent increase in numbers within the original habitat, nor in a colonisation of new territory. On the contrary, indeed, it would seem



Oliver G. Pike

GREY LAG GOOSE AND AUSTRALIAN WILD FOWL

Once the grey lag goose (bottom) used to breed regularly in Norfolk, but now it is chiefly as a winter visitor that this bird is seen in England. The impression of eagerness in its flight cannot be forgotten when it has once been seen, and is largely due to the long, stretched forward neck. The upper photograph shows migrant Australian wild fowl in flight.



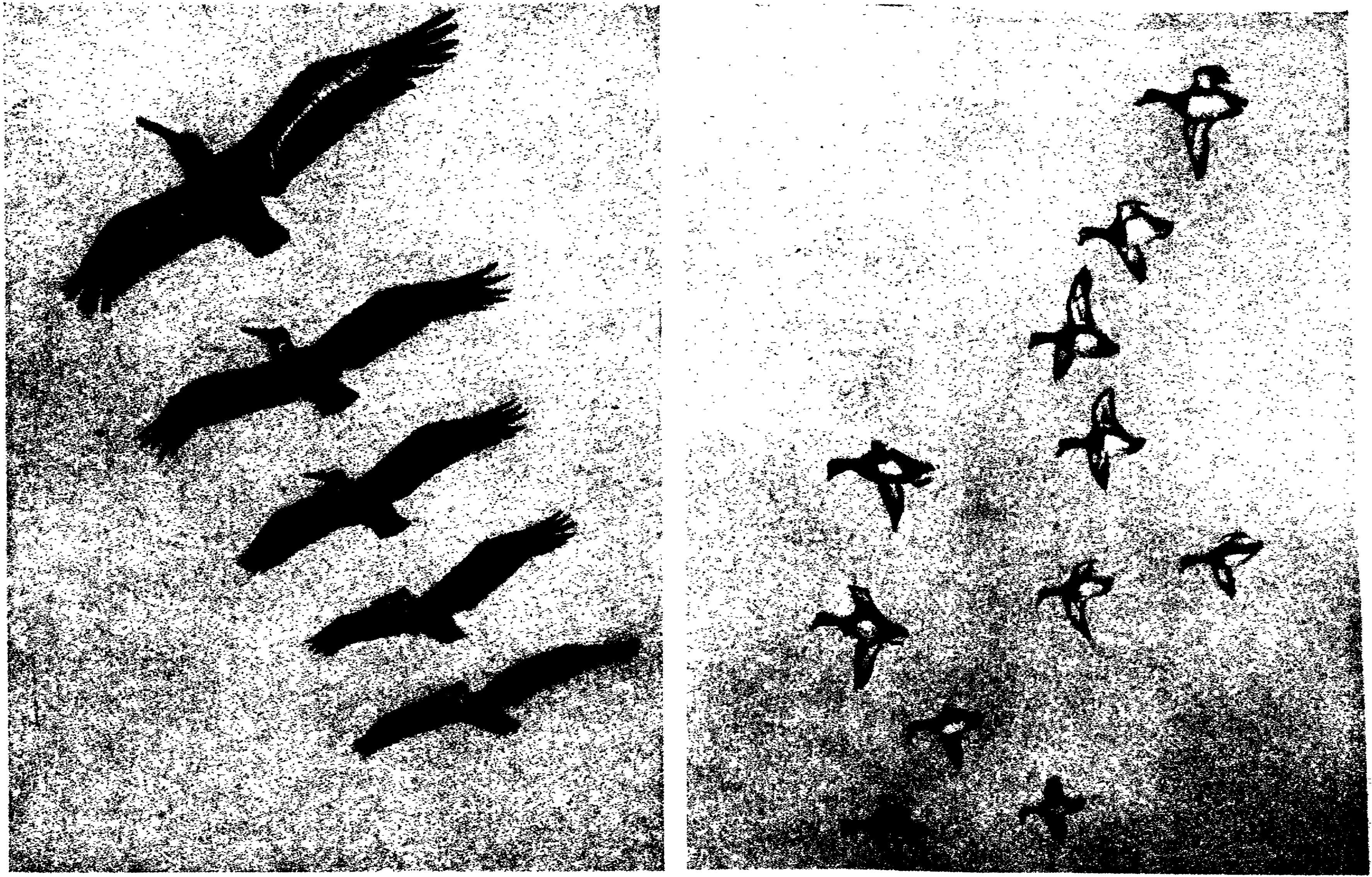
ARROW HEAD OF WILD GEESE ON THE WING FOR THE LONELY NORTH

That the Irish gave to those of their compatriots who, in the eighteenth century, left their country to seek their fortunes abroad the name of " the wild geese " suggests that these birds are, in actuality, great wanderers and travellers. The wonderful flying wedge moving remotely across the sky but travelling very fast, which is a flock or gaggle of geese, is one of the most stirring sights in wild nature. So high can these wonderful birds fly that they cross the Himalayas, and it is thought that they then reach an elevation of over six miles.

that not only do most of the migrants die without leaving progeny, but that as a result of the migrating process the original habitat shows a diminished lemming population for many years afterwards. If, however, the period of abnormal weather conditions which we have assumed to be the cause of the sudden increase of numbers had not been a mere variation, but an indication of the approach of a secular climatic change, an extension of the range of the species might have taken place.

Such an extension, though not due to a climatic change, has taken place in the case of the brown rat. Originally, it would seem, a native of Western China, this animal is known to have penetrated into Europe from Asia in the early part of the 18th century. It swam across the Volga, and migrated along the line of rivers and canals. This was the beginning of an enormous and world-wide extension of range, accompanied by a great increase in numbers. Rats share with the lemming and many other kinds of rodents the habit of migrating in bands when the local food supply fails or conditions prove unfavourable. But the success of the brown rat, as compared with the failure of the lemming, is due not only to its omnivorous habit, its intelligence and ferocity, but to the way in which it attaches itself to man and finds food and shelter in his buildings, storehouses, corn ricks and so on, so that it is in part protected from the struggle for existence as it affects truly wild animals. Its success is aided by civilised man's habit of destroying, wantonly or of necessity, the predatory animals which find in such small rodents their natural prey.

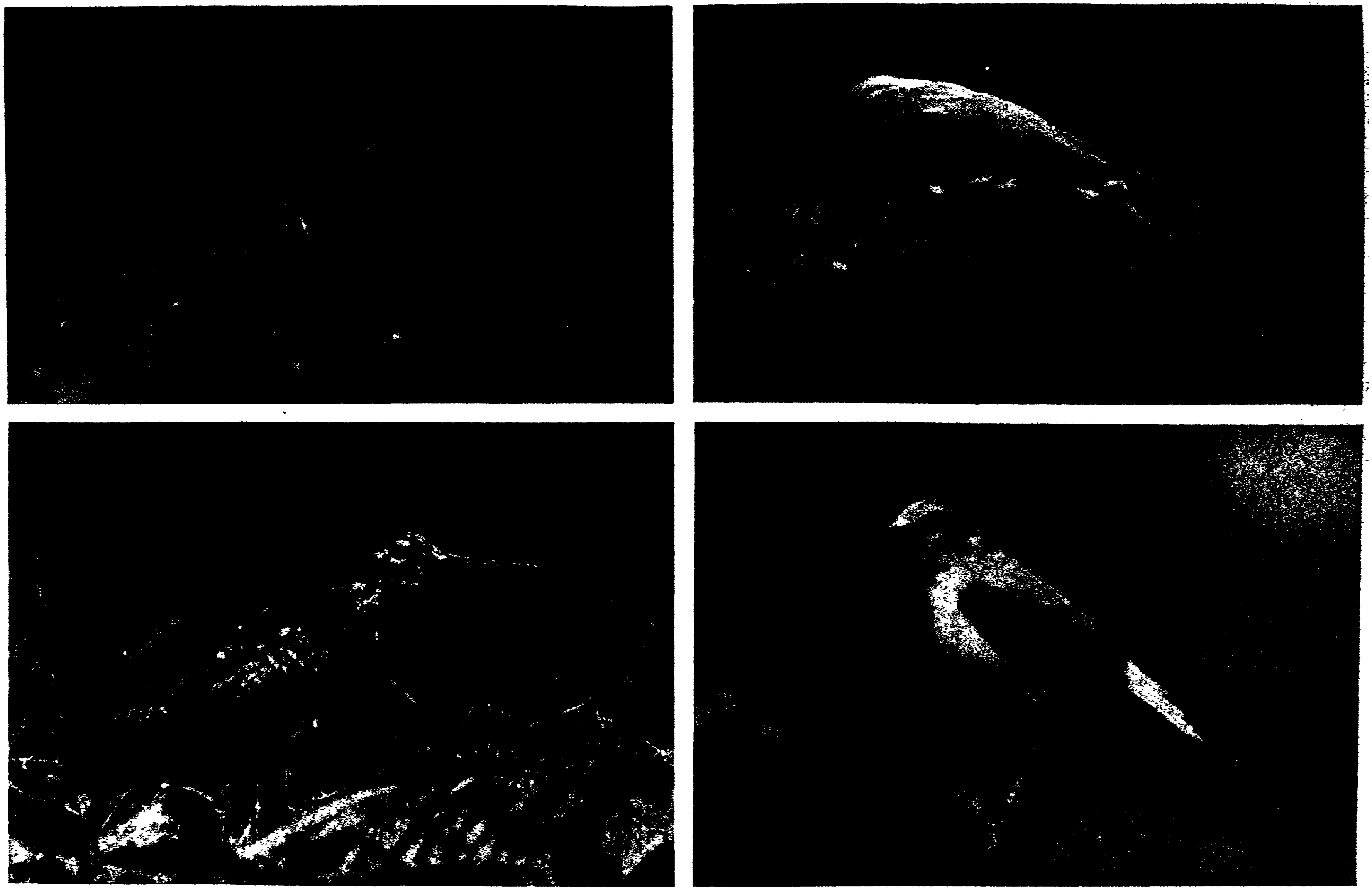
Still another type of movement is illustrated by the wandering ants (*Eciton*) of Central and South America, animals again as remarkable for their numbers as for their destructiveness. They are true nomads, not forming permanent homes like most social insects, but moving from place to place in search of food, the temporary nests serving merely as nurseries for the young. The ants on occasion invade man's dwellings in great bands, and then disappear, giving the impression of an army on the march. But again the explanation is simple. The lands in which they dwell show little seasonal change, but the social habit of the insects means that the resources of a particular area are soon, though temporarily, exhausted. The ants have therefore acquired the nomadic habit, though if all the facts were known it would probably be found that the range of the raids of any particular



E.N.A.

BROWN PELICANS AND WILD DUCKS AND THE FORMATIONS IN WHICH THEY FLY

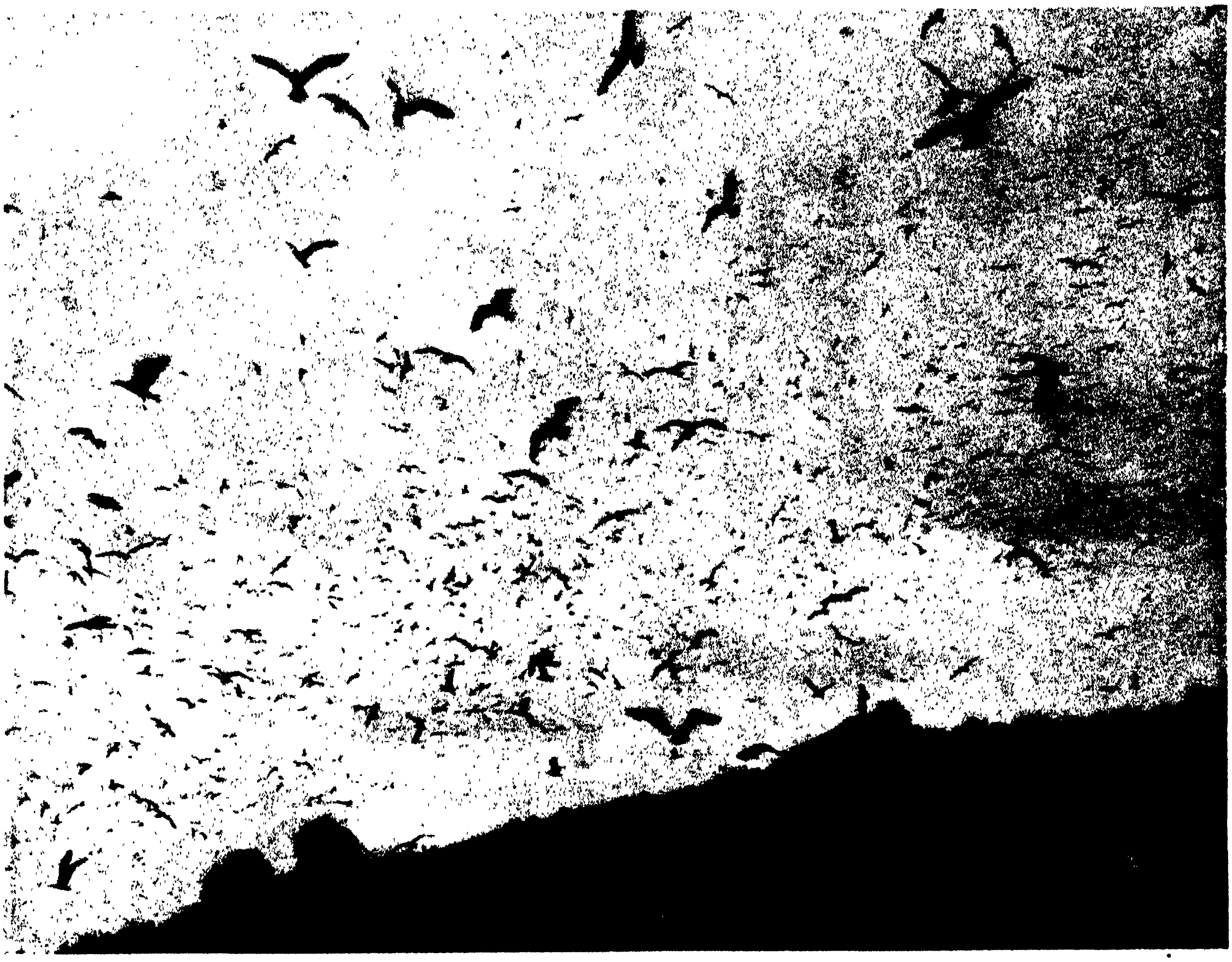
While the pelicans may seem about as clumsy as possible on land yet they are extremely powerful flyers, taking up formation in long lines and maintaining them with as much precision as a squadron of fighting aeroplanes. These lines in which they fly may comprise hundreds of birds and are a most impressive sight. Pelicans fly with the neck bent back over the body and the huge beak resting on the breast. They make considerable journeys to and from their feeding and breeding grounds, estuaries and lagoons being their favourite haunts. Skeletons of pelicans have been found in the fen districts of Cambridgeshire, but the birds never visit England now. The right-hand photograph shows wild ducks. They can attain a speed of a mile a minute.



W. S. Berridge

FOUR STRONG-WINGED VISITORS TO THE BRITISH ISLES FROM FAR COUNTRIES

Found over the greater part of Europe and Asia, the woodcock (bottom left) breeds over a very wide area—northwards as far as the Arctic Circle and southwards as far as the Alps and the Himalayas. Those individuals which breed in the south are probably residents, but those from the north are migrant. Many of the latter visit the British Isles in the autumn. The wheatear (bottom right) comes north in the early spring to breed, arriving in March and being one of the earliest migrants in Britain. The cuckoo (top left) having seen its young safely launched into the world in the care of foster parents, leaves for the south some time before its offspring are ready. The waxwing (top right) is another visitor to Britain from afar.



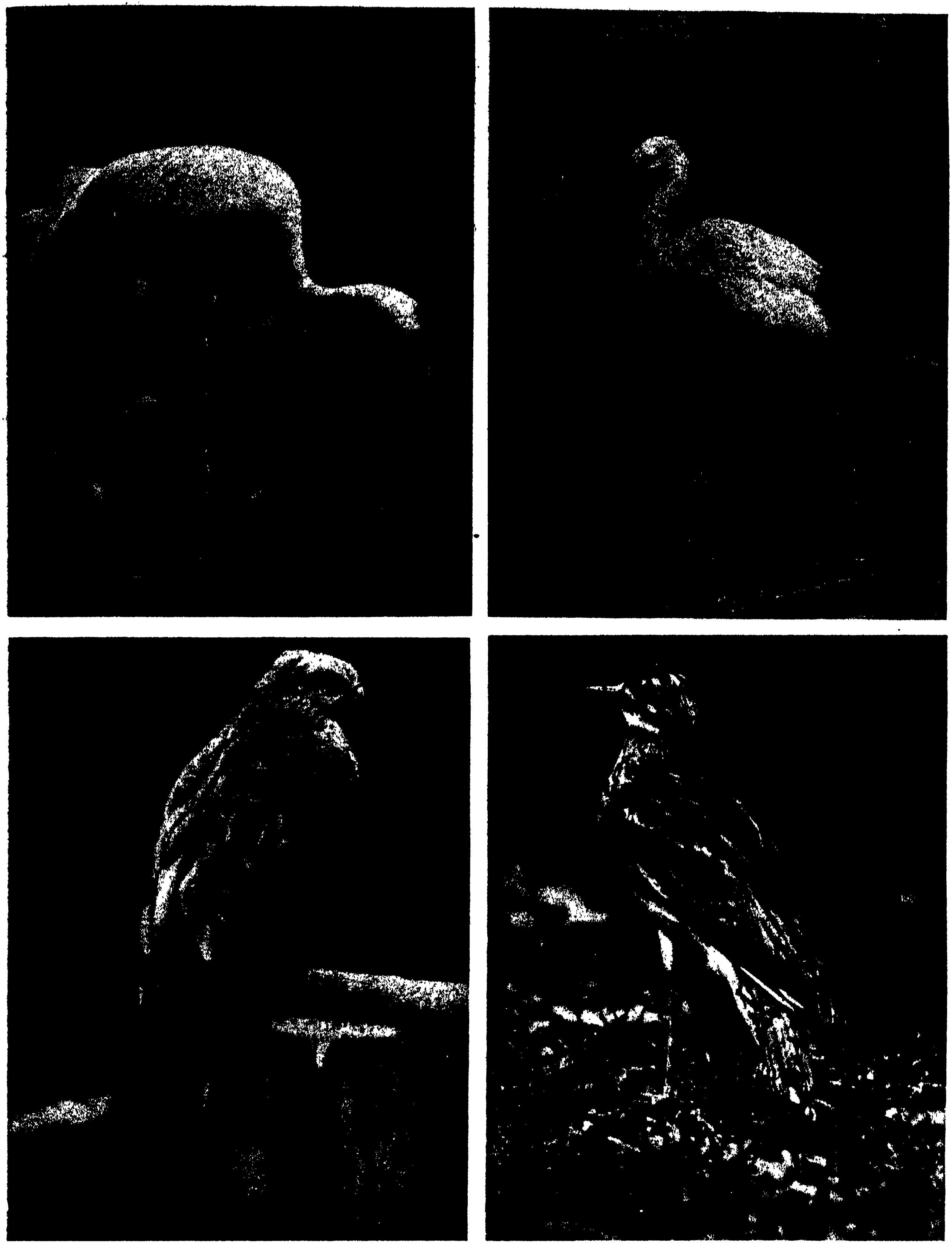
E. N. A

MALLARDS AND A GREAT CONCOURSE OF GULLS

Most abundant of the fresh-water birds of Britain, the mallard or wild duck resides in considerable numbers in England throughout the year. But much greater numbers arrive from Europe during the winter (bottom), the mallard being a very strong and swift flyer. Gulls (top) are all either wholly or partly migratory in their habits—restless wanderers over the face of the sea.

horde was always small. Essentially the raiding habit here is a form of response to the enormous and virtually continuous productivity of the hot-wet lands of the earth. The bands may appear to destroy everything in their passage, but nature repairs their ravages so rapidly that growth—in the absence of any marked seasonal check—can keep pace with destruction and new resources are always available in some part of the zone of operations.

Many other types of mass-movement exist. The swarming of the hive bee, the nuptial flights of many kinds of true ants and of termites, or white ants, for example, illustrate the way in which sedentary social insects ensure the spread of the species. But none of these movements is comparable in



W. S. Berridge

KITE, CURLEW, CRANE AND STORK THAT FOLLOW THE SEASONS CHANGES

Birds which migrate have the instinct very deep-seated, and all its workings are not clear to us. But some of the causes which prompt these great journeys are obvious enough. The arrival of a bird in the land where it chooses to nest coincides with the natural multiplication of its food—insect, vegetable or animal. In going north, too, birds get more hours of daylight in which to find food for their hungry young. These photographs show (bottom left) a kite; (bottom right) a curlew; (top left) a crane, and (top right) a stork.

Natural History, N.Y

SWARM OF BUTTERFLIES RESTING DURING MIGRATION

Under normal conditions there is a tendency for races of animals to spread over the earth This tendency is checked by the interaction of one species upon another. Our photograph shows a swarm of monarch butterflies in the U.S.A. during the great southward flight they make every autumn.

interest to true migration as illustrated by birds. Bird migration may indeed be said to be one of the most wonderful phenomena of the animal world, and of it, as yet, we are able to give no completely adequate explanation.

THE main facts are now fairly well known. A great number of different kinds of birds travel northwards in spring to nest and rear their young in cool, temperate or even Arctic latitudes. As autumn approaches these birds manifest great restlessness, often collecting together in bands. At certain dates, more or less fixed for the species, and showing no very close relation to the prevailing weather, mass movements to the south set in. The migrants follow definite lines, which can now be more or less accurately plotted on the map, and often travel enormous distances, so that birds which nest in Northern Europe or North-West Asia may winter in Africa south of the Equator, and others nesting in North-East Asia may winter in the Malay region or even in Australia. There is no corresponding large-scale movement of nesting forms into south, temperate or Antarctic latitudes, a fact which may be associated with the narrowing of the southern continents, their limited extension into temperate latitudes and the general unsuitability of the Antarctic continent for land plants and animals. Further, it should be noted that not all forms which breed in high northern latitudes migrate across the Equator in winter. The redstart is an example of a bird which breeds as far north as the North Cape in Europe, but does not in winter extend beyond the northern half of Africa.

The migrating instinct, where it occurs, is clearly both deep-seated and long-established. Though we do not know all the causes of its origin, part at least of its value is easily realized. The nesting process results in a great and sudden increase in the bird population, with a resultant heavy demand on food supplies. In temperate and even Arctic latitudes the spring renewal of life means just such a sudden increase of resources as is required. Insects in particular—a very important element in the food of birds—become very abundant.

An even more important factor is probably the length of the day. Most birds, like many insects, are active only by day, and the former require daylight to find food both for themselves and their nestlings. It has been found that in parts at least of areas in the higher latitudes, broods are larger and nestlings grow more rapidly than in the case of the same species when nesting in lower latitudes. This is associated with the greater number of hours during which feeding can be carried on. Again, it is found that some small tropical birds will not live through the winter in the north, even in well-warmed aviaries, unless artificial light is supplied so that they can feed during the hours of darkness. This makes it probable that the curiously punctual departure of many summer migrants, which so often seems independent of the weather, is caused not by falling temperature but by diminishing daylight. Such a view helps to explain why the adults not uncommonly leave before the young birds, for the latter, which have been fed by their parents, must have greater reserves than the breeding adults, who have expended much muscular energy in obtaining food from which they derived no benefit.

Chapter XCV

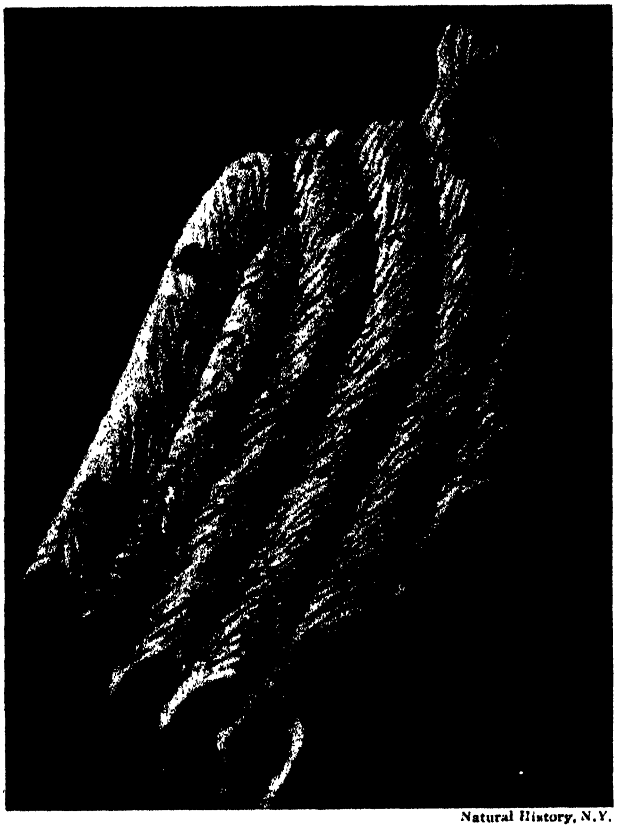
Marvels of Animal Craftsmanship

By Lewis Spence

The nature of that which we call instinct in animals is still as dark to us as the secret of the origin of life itself. Those who have investigated it have too frequently been under the impression that the mental processes of animals are bound, in a measure, to resemble those of man himself. However that may be, instinct in animals appears more as a hereditary and native quality, like that of self-preservation, than reason pure and simple. That animals do employ reason on occasion is a proven fact, but this seems to occur more in sudden encounters with exceptional situations than in the round of their everyday existence.

Men, to excel in any craft, must labour for years in an apprenticeship of hard-won knowledge; but the beaver, the spider, and the bee enter into a phase of journeyman skill at an age when humans are still helpless and infantile. That in many cases they are actually instructed by their elders in the natural crafts which their several species have developed is scarcely to be disputed, but the aptitude with which they learn is eloquent of the presence of natural and inherent qualities the origin of which is still dark to us. There are no unskilful builders among the bees, no imperfect carpenters among the beavers, no second-rate spinners in the spider world; and in none of the teeming cities of the ants has the question of unemployment been known to present itself.

Still, amazingly clever as the craftsmanship of many animal and insect societies may be, they are nearly all limited to one particular direction of effort which, in the majority of instances, is associated either with their methods of procuring food, or is designed for their self-preservation. They resemble the craft-castes of India, in that their generations adhere to the one trade; they are like Mr. Wells's men in the moon, who herded in craft colonies.


Natural History, N.Y.

MUD-WASPS' NESTS LIKE PAN'S PIPES

Though the mud-wasp never sees its children it makes very careful provision for their welfare, constructing these wonderful nests from mud, stocking each one with stung and paralysed caterpillars, and leaving the eggs to hatch and the larva to feed on them.

But although the motive power of these activities is attributed to that mysterious inspiration which, for want of a better definition, we call instinct, they are frequently of such a nature as to excite our utmost admiration, and even our envy, and we are forced to confess that we superior beings have learned not a little from the subtly clever, intricate and often beautiful creations of animal artificers. Nor do these architects and engineers, these decorators and jewellers, invariably rely on inherited and natural skill. They have been known to think for themselves, to break away from tradition, to evince mental traits which seem to show that other forms of life save man are capable of some degree of conscious self-development.

Surveying first the craftsmanship of the mammalian world, we find ourselves most naturally observing those artificers whose engineering skill must, at an early era, have supplied man with more than one useful hint, the beaver family. The Canadian beaver is a naturally gregarious creature, although his reputation as a "good mixer" seems to be limited to the family, yet it frequently takes a tribal turn. His "villages" consist of a congerie of "lodges," situated in running water, each of which contains some half-dozen individuals—father, mother and little ones—and the work of construction proceeds as these set up house for themselves and the site becomes congested. These lodges are in reality dome-shaped gateways to one end of their burrows, the other being under water; and as the main design is to keep the stream in which they are situated at a constant level, so that the subaquatic entrance may not be exposed, it becomes necessary, in order to effect this, to build a dam right across the river.

A sluggish stream is dammed straight across, but swifter-running

water is crossed by a V-shaped construction not unlike the shape of the piers of a Roman bridge, in order that the force of the current may be broken more gradually. The logs are laid horizontally, covered with mud and stones, and bound together by withes and branches from the felled trees for greater security. Some of the larger dams actually cover a distance of three hundred yards, and may be as thick as ten or twelve feet. The lodges are usually contrived of twigs and branches, plastered with mud and lined with grass, and here the beaver folk huddle during the long Canadian winter.

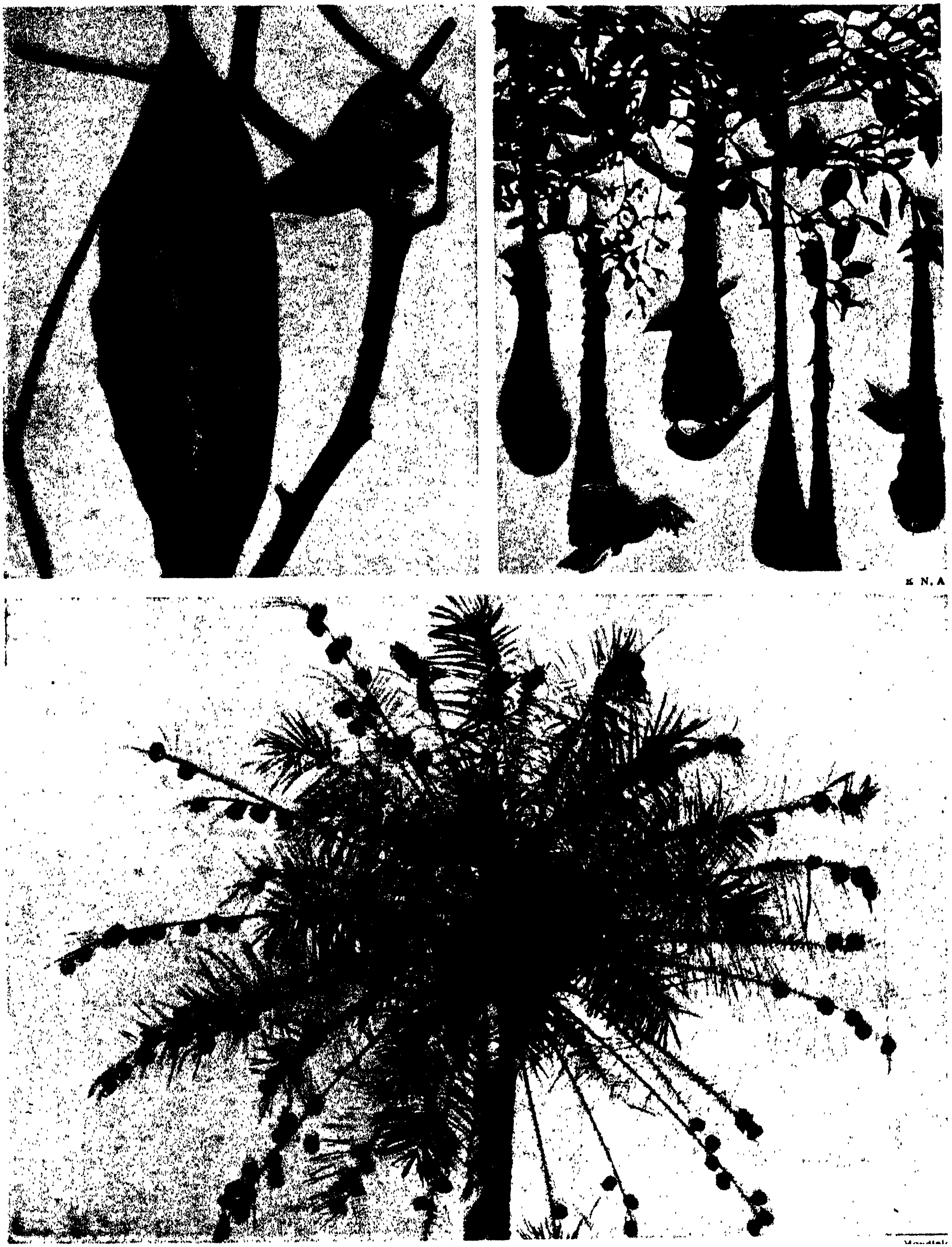
Many mammals, like some races of early man, live as much beneath the earth as upon it, and this habit of self-protection has endowed them with wonderful powers as sappers and miners. The fox, the mole, the badger and the gopher are all professional tunnellers whose very lives depend upon their skill and prowess in this direction.

The mole, with his gimlet-shaped proboscis and shovel-like feet, works much nearer the surface than might be supposed; so near, in fact, that his progress may frequently be noted directly under

M. N. A.

BEAVER CRAFTSMEN AND THEIR DAMS

As aquatic engineers the beavers know all about their business, adjusting the formation of their dams to the exigencies of swift or slow-running water. We see two at work on a dam (bottom) and a big dam in Montana (top). Beavers are very shy and difficult to photograph.

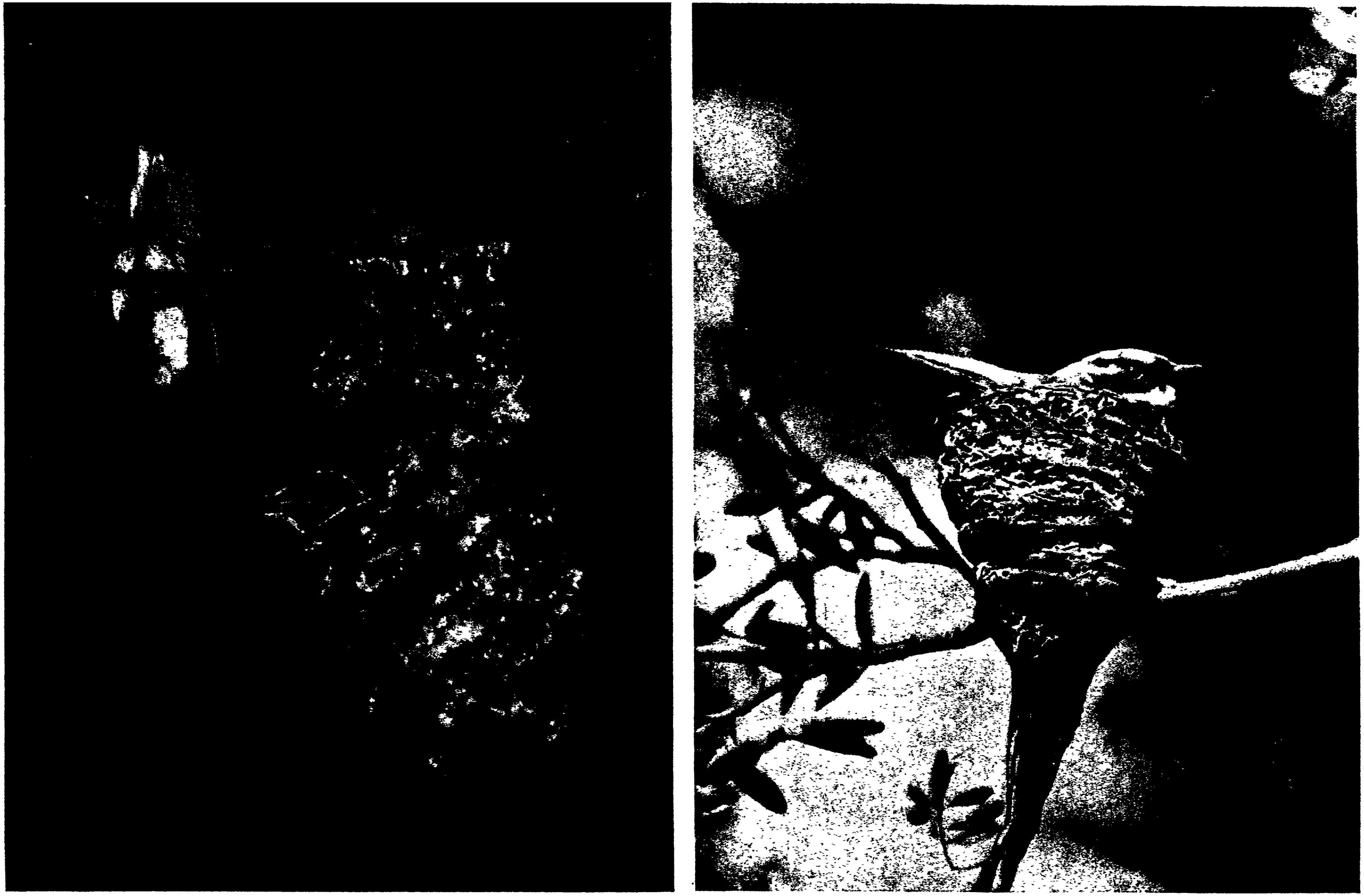


E.N.A

Mondiale

WEAVER BIRDS' NESTS IN AFRICA AND A TAILOR BIRD AND ITS NEST

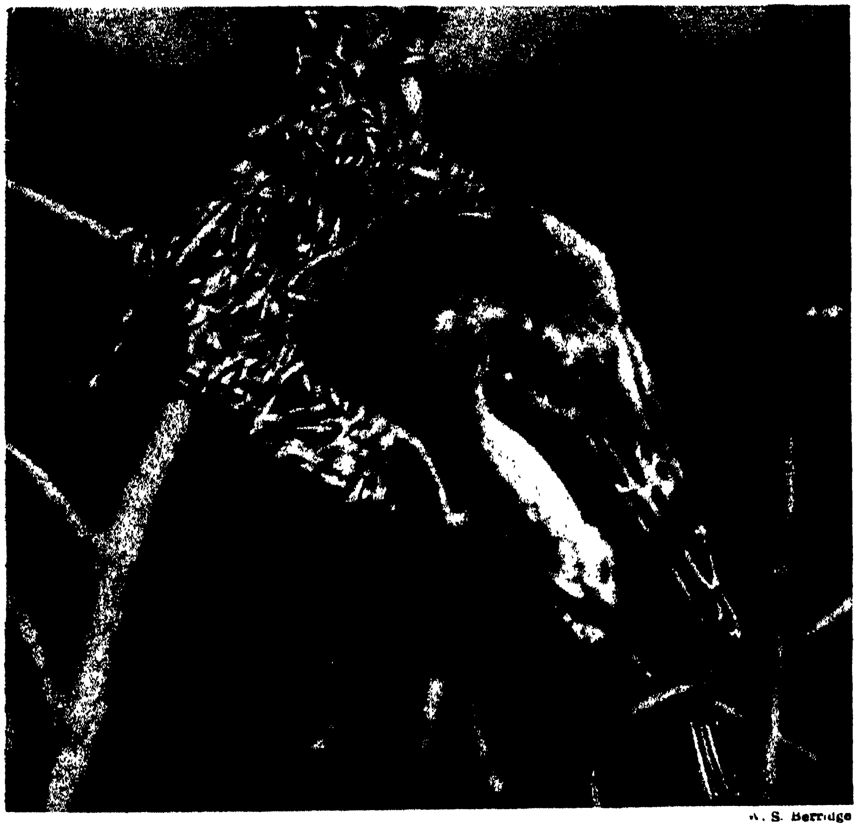
Superficially the weaver birds, which are very widely distributed from Africa to Australia, much resemble finches. The bottom and top right photographs show nests of African varieties from Sierra Leone and Tanganyika. One kind builds in a tree with a company of its fellows so that it looks as though the branches bore some strange new fruit. The other builds long, slender, flask-like nests. The top left-hand photograph shows a tailor bird and its remarkable nest, from the Dutch East Indies.



AUSTRALIAN BUILDERS OF WONDERFULLY DELICATE NESTS: MISTLETOE BIRD AND FANTAIL

Mistletoe birds, which live in Australia, build their nests of wool or, failing that, wool-like fibres from plants. These fibres, or the strands of wool, are short and quite unlike the long strands which other birds use, and the whole substance of the finished nest has the texture of felt. But it is strong, for it supports several young birds and one or other of the parents at the same time, as we see above (left). The right-hand photograph is of another Australian bird, the fantail. This constructs an exquisitely delicate nest out of bark and spiders' webs. It is shaped roughly like a pipe bowl, and this idea is strengthened when a branch projects from one side of it, as happens when the base of the nest is built round a twig of the stem which supports it.

the turf. In constructing his subterranean nest, he first digs a round hole slightly below the surface, pushing the earth upward as he proceeds. But he is not content with one tunnel for entrance and exit. He requires at least another from which to eject the ever-falling soil which dribbles into his nest, and for a bolt-hole; and this is usually designed in corkscrew form, for the double reason that the earth may not drop down so readily and that he may the better be able to elude pursuit. Should the soil where he has elected to nest be of a boggy nature, he digs still other galleries for the purpose of bringing earth to heap over the nest. The nest itself is spherical in shape and about the size of a large melon. It is composed of a ball of grass or leaves, every scrap of which has to be conveyed to it in the mouth. It is invariably closed, even when it contains the family of young ones.



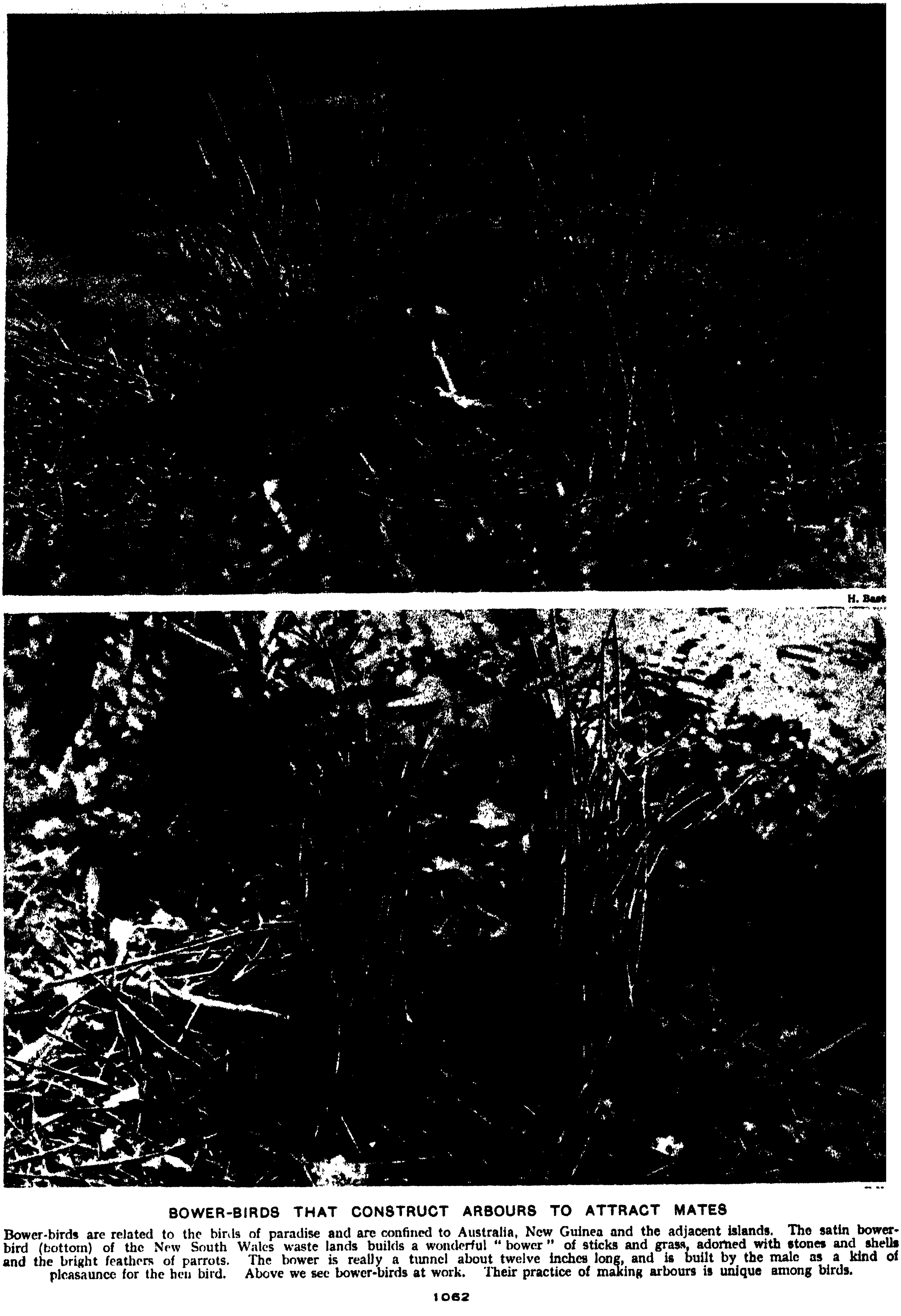
A. S. Berridge

HOW THE NESTS OF THE WEAVER BIRDS ARE BUILT

Below we see a red-billed weaver bird of East Africa in the process of building its nest. Certain kinds of weaver bird make communal nests of twigs, so closely interwoven as to bar the entrance of anything save a very small snake. The same nest is used year after year, dilapidations being made good by all tenants. Above are weaver bird nests from Bengal.

A SAPPER peculiarly expert is the Arctic fox, which, unlike the English Reynard, is communal in its habits, dwelling in large subterranean societies or "villages," but keeping nevertheless to its own compartments. Because of the Arctic cold, its burrows are extraordinarily deep, with a kind of "living-room" at the end of the entrance tunnel, from which lesser "apartments," nurseries and dormitories, branch off. Not infrequently the entire "house" is connected up by the most complex passages.

But an American tunneller, the prairie dog, has him beaten to a frazzle in the matter of cunning excavation, for his plans are as precise and as well-laid as that of the engineer of a London "tube." "Underground to anywhere" is indeed his native motto, the very philosophy by which he lives. Entering the earth at an angle of forty-five



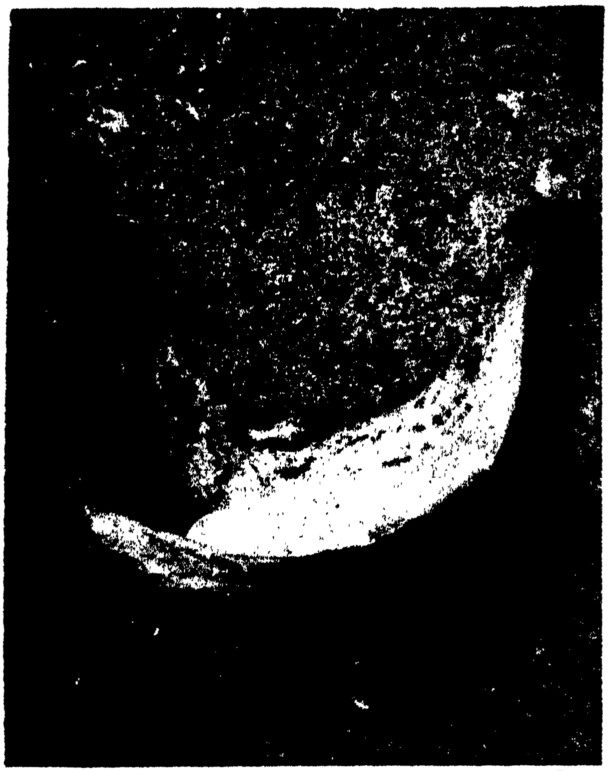
H. Bast

BOWER-BIRDS THAT CONSTRUCT ARBOURS TO ATTRACT MATES

Bower-birds are related to the birds of paradise and are confined to Australia, New Guinea and the adjacent islands. The satin bower-bird (bottom) of the New South Wales waste lands builds a wonderful "bower" of sticks and grass, adorned with stones and shells and the bright feathers of parrots. The bower is really a tunnel about twelve inches long, and is built by the male as a kind of pleasaunce for the hen bird. Above we see bower-birds at work. Their practice of making arbours is unique among birds.

INCUBATORS BUILT BY BIRDS WHERE THE EGGS HATCH BY THEMSELVES

Certain Australian birds do not sit on their eggs but make a mound of vegetable matter and bury their eggs in that. The heat of the mound, decomposing in the sun, hatches out the clutch. The lower photograph shows the mound made by the hen of the mallee fowl. The eggs are laid in layers, separated by sand, and in very hot weather the top of the mound is removed by the bird, as we see here. Above is the incubator of a brush turkey which is equivalent to many cartloads of vegetable matter and takes several weeks to collect.



H. Bastin

NEST OF THE EDIBLE SWIFT

Despite the name, it is not the swift which is particularly edible, but its nest, made of the secretion from the salivary glands which the Chinese make into soup. The photograph shows how a kind of cup made of solidified saliva is fixed to its support.

degrees, and extending downwards for about five feet or thereabouts, his main passage takes a sudden sharp turning, ending in his reception room. But as he is a sociable little fellow, he burrows into the parlours of his next door neighbours. His cities are spread over enormous areas in the deserts of North America, and the odd thing is that he seems to be able to carry on with almost no water supply.

The pocket-gopher, another North American animal, burrows expressly to find the roots of plants. Armed with formidable claws, he tunnels down to the roots of a tree in short order, and constructs his nest of dried grass between its fibrous walls, hollowing out two chambers, a nursery and a larder.

Some animals are as expert in nest-building as their feathered neighbours. The bettong, or brush-tailed rat-kangaroo of Australia, is an ingenious architect which seeks a hollow in the ground, and roofs it over with grass and leaves, which she gathers and carries back to the nest, by rolling them into a bundle with her tail. The squirrel's nest has been described elsewhere, but those of the man-like apes deserve passing mention. The chimpanzee builds his of branches bent to shape, forming a substantial platform about 28 feet from the ground, and frequently secured to the trunk by the stems of creeping plants. Some of these structures are, however, mere canopies to keep out the heavy tropical rain. But, on the whole, birds certainly exhibit a higher degree of craftsmanship than most animals, and frequently extraordinary skill is to be observed in their methods. The humming-bird, for example, employs the web of the spider as a building medium, not only to hold the mossy fabric together, but also to attach it to the leaf on which it stands. This tiniest of the winged people also exhibits much skill in producing an exact balance for its nest, so that the eggs may lie securely, and to effect this it daubs mud or even introduces small stones into the structure so that the proper degree of equilibrium is secured.

The British chaffinch is a model nest architect. She invariably selects a firm foundation, and by interweaving wool with moss, thistle-down and spiders' webs, produces a marvellous structure, both firm and elastic, which is always wonderfully camouflaged. Some weaver-birds build a communal nest in harmony with their social instincts. Indeed, these birds live under one roof, often to the number of three hundred. The structure is built of bushman grass in an acacia tree, and looks like a mass of matted hay pierced by holes.

The " pedrero " or stone-mason bird, found in the south of Spain, builds a dry-stone " dyke " along the front of the space which the nest is to occupy, and the stones of which it is composed are frequently so heavy that how it manages to convey them to the spot is something of a mystery. Inside this barrier it builds a well-upholstered nest. But foundations of " masonry " are not uncommon even among British birds; for example, the ringed plover, and the blackbird and magpie, whose nests often have a base of dried mud. Swallows and house-martins build by sticking together pellets of prepared road-mud, obtained from drying puddles on the highway, and mixed with a mucous secretion from the bird, which acts as mortar.

Many foreign birds build hanging nests of extraordinary form, pear-shaped, bottle-shaped, and so forth. The Baltimore oriole, an American bird, suspends its nest from a branch, weaving it piecemeal until it takes the form of a straw hat half-finished. The basis is strong fibre surrounded by finer material and lined with horsehair, nor will the little builder be content with anything but the correct and appropriate materials, looting the entire countryside for bleaching threads and hanks of silk.

THE pied granilla is a worker in clay, mixing th muddy basis with twigs, feathers and grasses, t form a stiff plaster which is hardened to a brick-lik consistency by the sun. Its dome-shaped sides hav a tiny opening, a mere gash in the clay, and a partition of mud gives it further strength and consistency, the male and female birds occupyin separate chambers during the period of incubation.

The edible nest of the swift, which is considere so great a luxury at Chinese dinner-tables, is forme by the saliva of the bird which somewhat resembl isinglass. These are found in limestone and volcan rocks, and as often as the birds build, the collecto remove their nests, which, in the Chinese market

NEST-CRAFT OF HARVEST MICE AMONG POPPIES AND YELLOW CORN

An acre of standing corn is a close-set forest of mystery wherein a secret, transitory life goes on until the reaper comes. There are rabbits and many birds there and, of course, the pretty, small harvest-mice. These twist straws together round three or four stalks to form a nest. Here we see young ones in the nest, and adult mice, their tails curled about the corn stems, eating the fruit of these miniature "tree tops."

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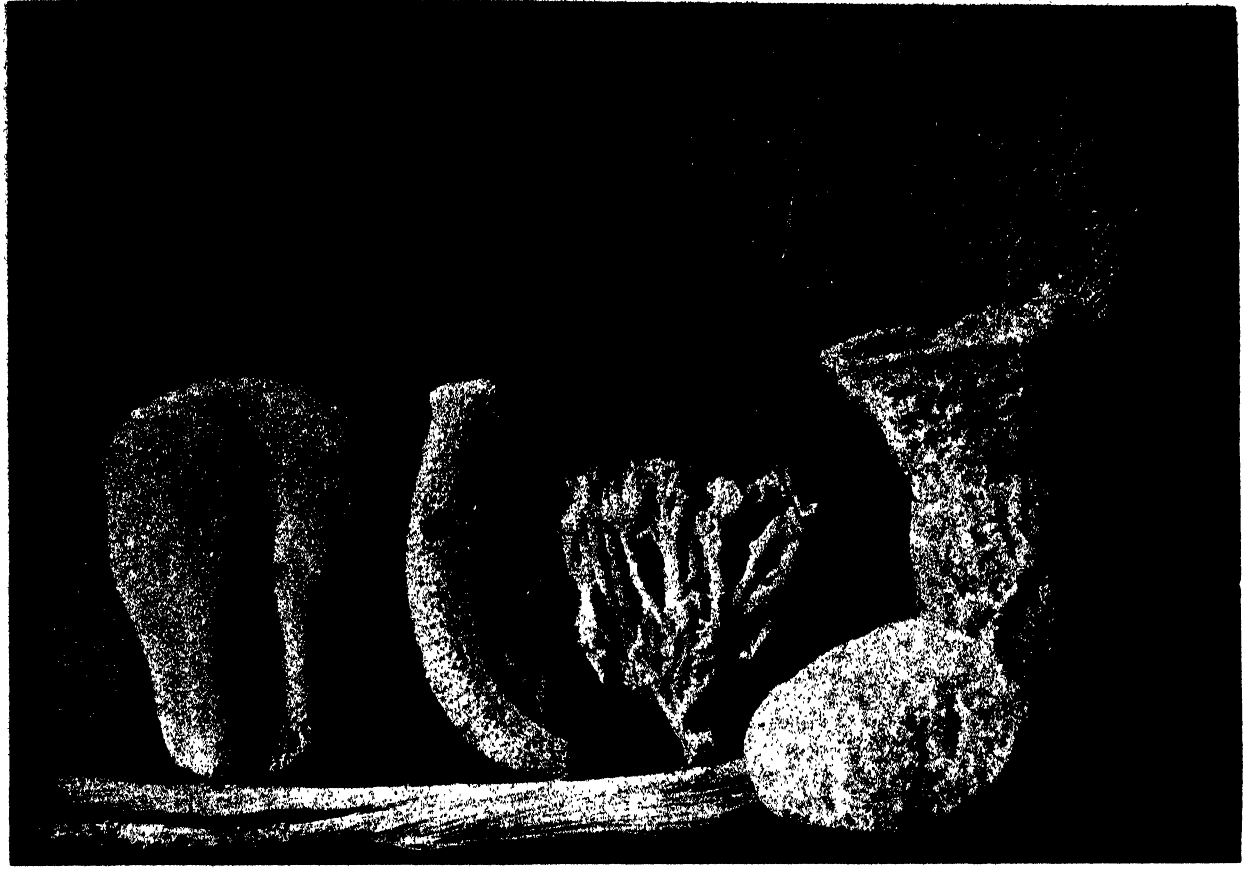


M. Duncan

WONDERFUL CRAFTSMANSHIP OF LOWLY SEA CREATURES

There are more kinds of sponges in the sea than ever were seen in a bath. It was not till the early nineteenth century that it was definitely known that the sponge was a colony of living creatures and not a sea plant. The forms and shapes are extremely varied and it is only those which, like the Turkey sponges of commerce, form horny skeletons, that are used for washing. On the right of this photograph are some sea fans contrived in beautiful lace-like patterns.

are worth their weight in silver for the purpose of making the far-famed birds'-nest soup.

For a long time the material from which the nest of the fiery topaz is made was a mystery to ornithologists. The small horn-shaped structure, with the point adhering to a branch, seemed to be made of leather, but it is actually contrived from a fungus of the genus Boletus, a tough and leathery growth, which the bird shapes deftly into the required mould.

Of cunning nests there is indeed no end, but to provide a worthy example a description of that of the tailor-bird will suffice. He builds his snowy structure in the folds of a leaf, sewing the edges together, using his beak as a needle by boring holes along the outer rim and then inserting plant fibres in the interstices. The leaf (or, perhaps, two leaves) is thus fashioned into a cone, the ends are knotted as a seamstress might do it, and the nest is introduced into the cavity.

AMONG bird carpenters the woodpecker is one of the few British species of this character, carefully excavating his nest-hole in a rotten willow, but seldom in sound oaks and elms, as popular fancy imagines. But he has, at least, once been badly cheated. In America the earliest telegraph poles were often damaged by woodpeckers, which mistook the humming of the wires for the buzzing of insects concealed in the poles and dug to find—nothing! He employs an oblique blow when he strikes for grubs, and his favourite prospecting ground is a tree which exposes a length of barkless wood, usually a Scotch fir. The ivory-billed woodpecker of the Lower Mississippi can chip off a piece of bark eight inches square with its powerful beak, and cartloads of bark thus detached from enormous pine-trees have not infrequently led explorers to believe that a gang of axe-men had been at work.

Eggs are productions which may legitimately be regarded as works of art, especially from the colour point of view. The eggs of the different species of birds have their especial peculiarities in surface texture and shape, those birds which lay in flat nests producing oval eggs which will not roll, and those which nest in holes, like the kingfisher or the owl, producing round eggs which roll easily.

The colour of eggs is usually a matter of protective camouflage, spots, veins and dyes usually agreeing with the natural surroundings of the species which lay them. The puffins, woodpeckers, kingfishers and

H Bastin

SCARAB BEETLES WITH THE FOOD PELLETS WHICH THEY MAKE

These large pellets—large, that is, when we compare them with their makers—serve the double purpose of providing food for the beetles and nurseries for their larvae. Dung is the material always used, and having moulded the substance into a ball, the scarab buries it and lays its eggs inside. In the above illustration we see how these industrious creatures manipulate their food supply. On the left two are co-operating, one pushing and the other pulling the pellet along.

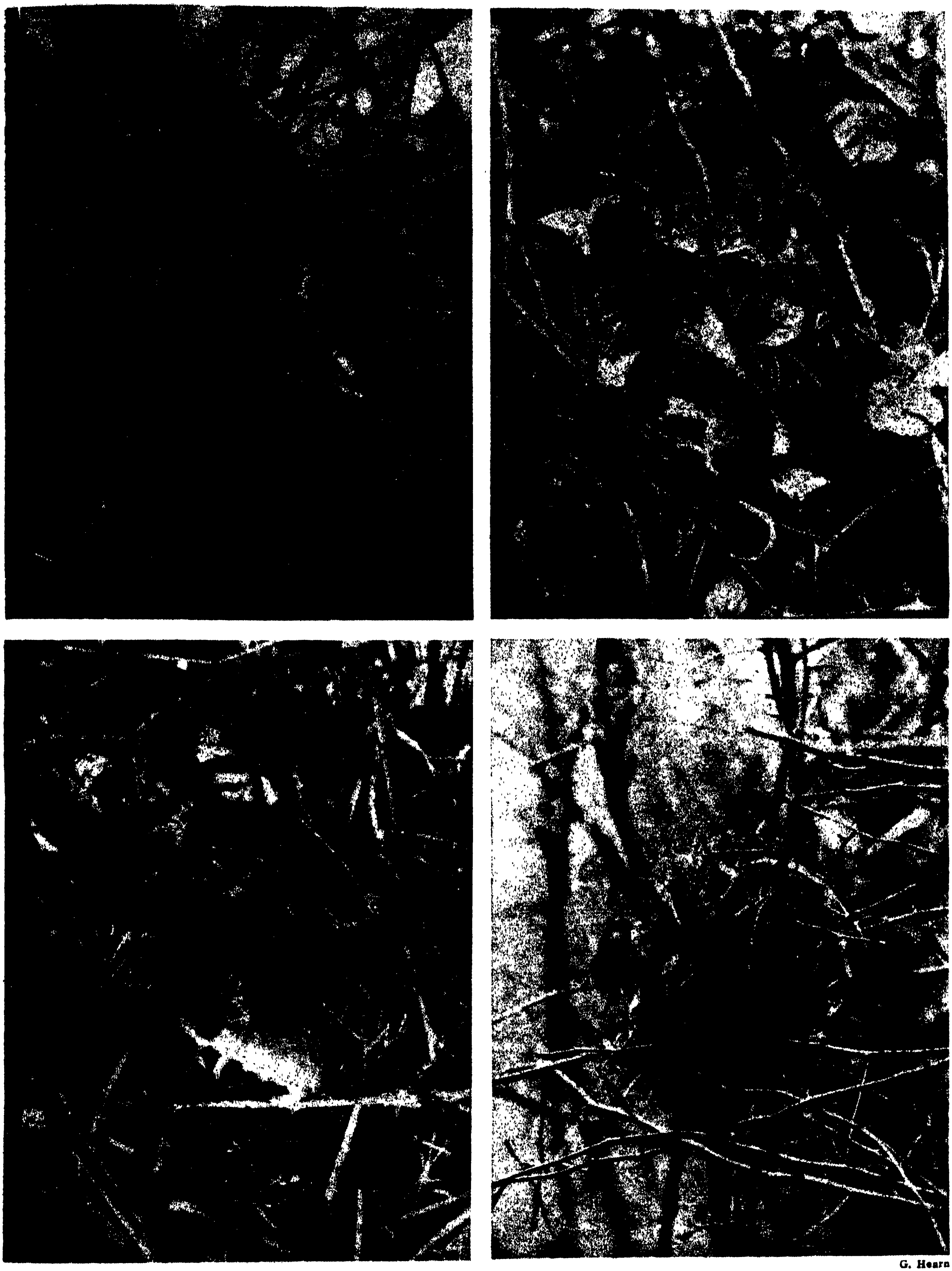
owls—all those birds, in fact, which cover their nests—lay white eggs, but those birds whose eggs are not so carefully concealed usually produce spotted or coloured eggs. Birds of brilliant plumage seldom lay brightly-coloured eggs, but eggs of greenish hue are usually laid by birds which nest in the early spring among green trees and shrubs, such as blackbirds, thrushes and crows. However, the magpie, difficult as her nest is to find, lays a spotted egg, as does the jackdaw.

Naturally the ground birds, like the lark, the pipit and the plover, lay eggs which harmonise with their surroundings, but none has brought the business of camouflage to such a fine art as the nightjar, whose eggs, streaked with brown or grey, tone in wonderfully with the colours of the furze bushes under which she lays them. The ringed plover, which always nests in sand, lays an egg covered with fine sand-like points, and the tern, which broods on the verge between sand and beach, imitates the colour of its environment marvellously in the oval with large, bold blotches which it produces.

HAWKS' eggs are coloured like the lining of the nest, and the sparrow's eggs shade in with the feathers which line her house. But the guillemot goes one better. She lays eggs of nearly a dozen different colours. These, in their exposed position on the ledges of rocks, are most conspicuous, and it must be in despair of imitating their surroundings that she colours them as she does; or else, trading on the inaccessibility of their position, she bursts out defiantly into a bizarre colour scheme.

On the whole, however, insects betray a much greater tendency to clever workmanship than either birds or beasts. The ubiquitous ant, whose social structure appears well-nigh human, is, as few are aware, a silk-spinner, weaving, while in the grub stage, those cocoons known as "ants' eggs" and sold as food for goldfish. Certain fungus-growing ants exist in tropical America which manure the soil in which they are raised with rotting leaves. Others harvest seeds which are stored in special granaries as food, and another Brazilian species actually designs and lays out gardens formed from earth carried into trees and built up into spherical sponge-shaped masses. In these certain plants are grown by the insects, so that the earthy particles may be held together by their roots.

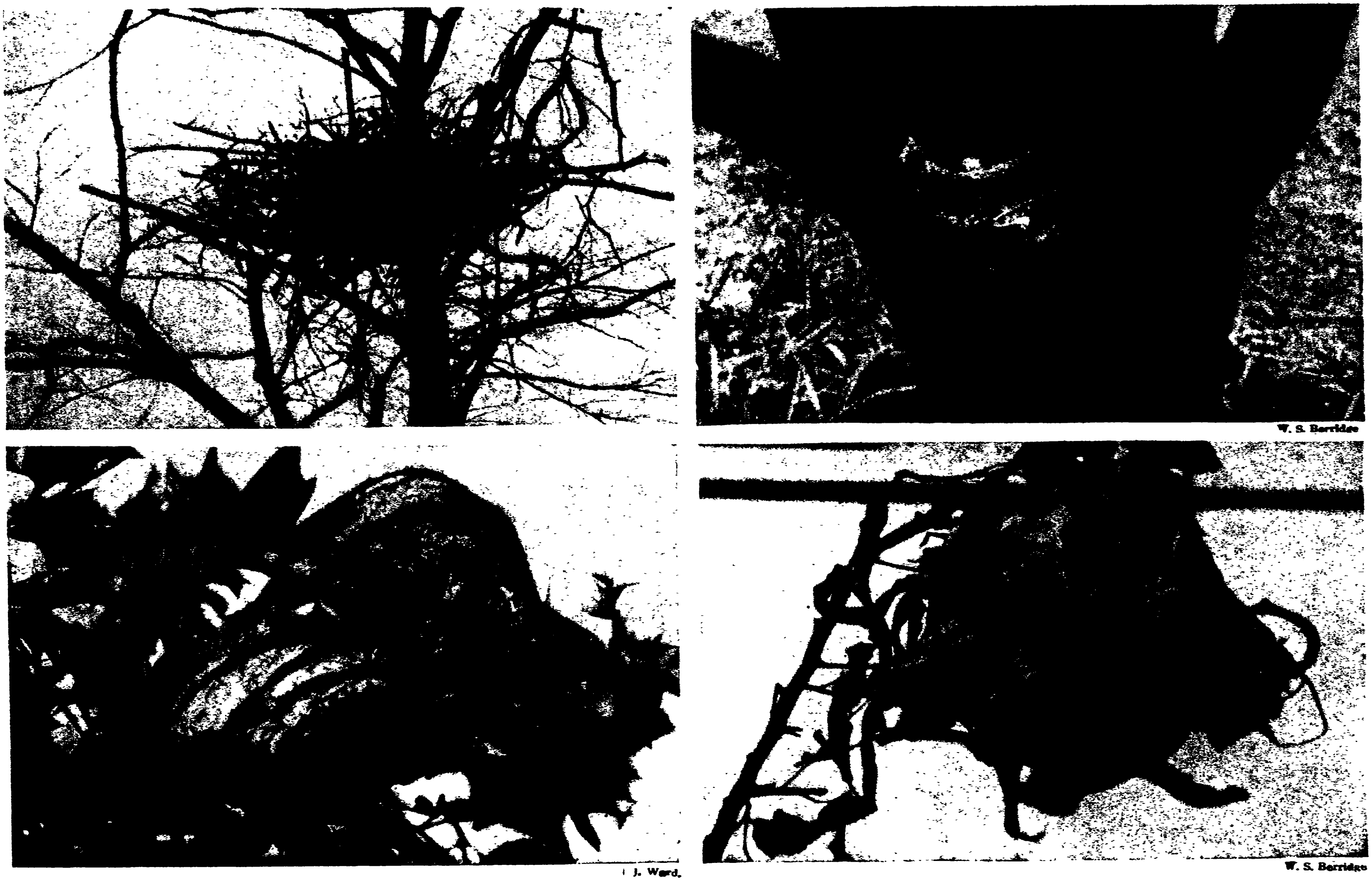
The termites or white ants are most industrious carpenters or wood-borers. In the tropics it is well-nigh impossible to keep furniture free from their ravages, and in an incredibly short time they can reduce a solid rafter, chair or table to a mere shell of seeming timber. Teak and the resinous woods alone are free from their attacks. In Britain the goat-moth larva, so-called because of the odour it leaves, tunnels through trees with its powerful



G. Hearn

SHORT-TAILED AND LONG-TAILED FIELD MICE AT THEIR CLEVERLY-BUILT HOMES

Voles and wood mice, known indifferently and rather incorrectly as field mice, make their nests either in the banks under hedges or in bushes or cornstacks. Above we have four examples of these intricate little structures made of grasses and twigs, where the young are born and hidden. Notice in the case of the male short-tailed field mouse (or field vole) seen in the top right-hand photograph how the nest is almost invisible amidst the surrounding vegetation which it is cunningly made to match.



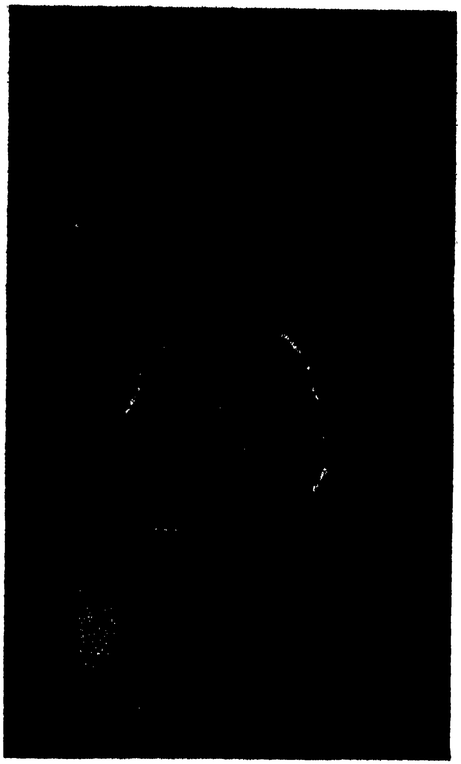
W. S. Berridge

J. Ward.

W. S. Berridge

FOUR EXAMPLES OF THE TREE NEST BELONGING TO ORANG, BLACKBIRD, TREE WASP AND ANT

Various creatures have put their trust in the trees for safe sleeping and we have four widely-differing examples here. First a most interesting and unusual example of the home of the tree wasp (bottom left). Here two nests have been built together, a sight which is very rarely seen. The double nest is photographed from below. The bottom right-hand photograph shows a nest built by tree-ants outside Calcutta, while above (top left) is the nest built by an orang-utan which escaped once from its cage at the London Zoo. It made off and had built this sleeping place before being caught. Lastly, we have (top right) a blackbird's nest made in a very exposed position, a few feet from the ground.



W. S. Berridge

J. J. Ward

jaws, and exudes a destroying acid calculated to reduce the stoutest wood to an easily bored pulp. Similar in action, and equally destructive, almost, is the so-called death-watch, a wood-devouring beetle whose tappings are merely the call of the female to her mate, five ticks in rapid succession. This tiny pest eats into furniture, depositing its eggs at the end of the tunnel it makes, the young, when hatched, carrying on the work of destruction. The larvae of the wood-leopard moth, another British insect, construct a cell so near to the surface of a tree that the partition is as fine as writing-paper. This gives them the chance to break out at any time, and yet their presence remains almost unobserved. The giant wood-wasp is equipped with a regular gimlet, and the sawdust of the timber she bores passes through her body as through the hollows of that instrument.

W. S. Berridge

TREE-WASPS AND THEIR ELABORATE HOMES

In the upper right-hand photograph we see a British tree-wasp's nest with the covering removed to show queen cells. On the left is a strange nest built by Brazilian tree-wasps cut to show the combs, and (bottom) some other tree-wasps' nest from S. America.

The resin-moth is a gall-maker, throwing out a long, fine, thread-like web, plunging it into the tissue of the leaf, and depositing there her eggs, accompanied by a drop of fluid which heals and seals up the wound in the plant, whether it be oak, willow or rose-bush. In each gall so formed there is a larva, and in autumn, when the leaves fall, the insect within is protected from frost and rain, hatching out in the spring as a chrysalis.

Cocoons are among the most beautiful products of insect life. Certain ants in tropical Africa actually employ the fine silk given off from the mouths of their larvae to repair the damaged sides of leaf-nests, using them as spools and shuttles, placing the mouths of the grubs against the leaf till the silk has adhered to it and sealed it up again. The silver water-beetle clings upside down to some water weed and spins a concave sheet of silk, which she attaches to the plant on which she stands. Then, assuming her proper position, she weaves a similar web and fixes both together so that they form a spherical cocoon in which she deposits her eggs. This tiny craft floats on the water, and in time the larvae are hatched out.

The egg-case of the cockroach resembles a diminutive vanity-bag. Within its horny structure her

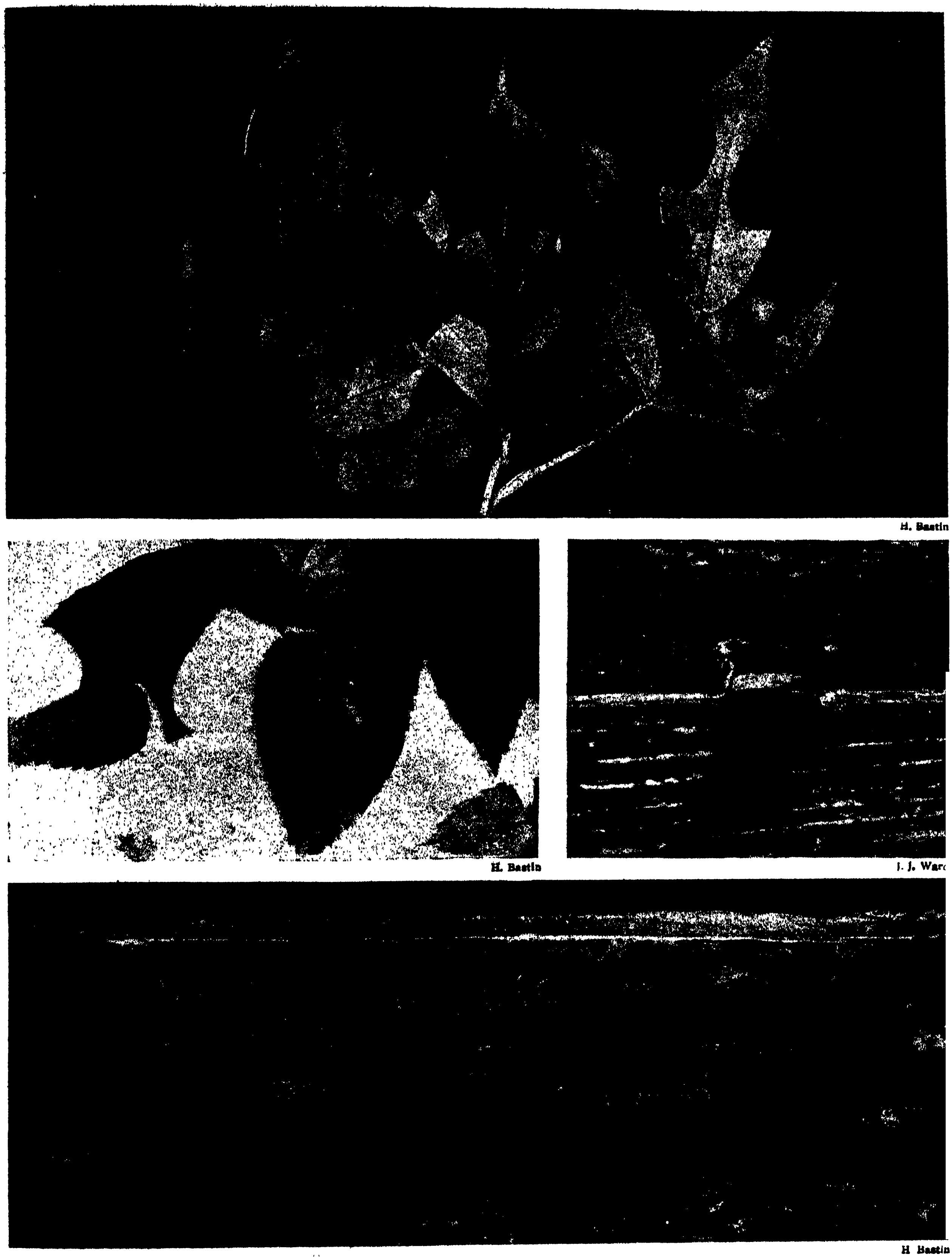
J. J. Ward

GROUND-WASP AND TREE-WASP WORK COMPARED

Below we have a ground-wasp's nest excavated to show how a stone was built into the structure because it was too large for the wasps to move. Above are three examples of wasp paper, the material of which the nests are made; on the left that of the ground-wasp and on the right two examples of tree-wasps' paper.

sixteen eggs are deposited, the top being held close by its natural elasticity. The mantis exudes a similar egg-case of froth, which hardens like the shell of an egg through the action of the air. Within this the young spin a silken thread, from which they suspend themselves like spiders, until they have shed their first coats and emerge.

The bee has such a reputation for craftsmanship in architecture, and her methods are so well known that little need here be said of them, especially as they are described elsewhere. In the manufacture of combs, the wax is produced by the worker bee through certain perforated wax-plates in the lower part of her body. Through these the wax oozes, and the insects, hanging together in groups, produce the scales, which are shaped into cell form by chewing and by the application of the nippers on the insect's hind legs. Some social wasps construct their nests from paper made of wood-pulp, in fact a South American wasp makes its nest of thick pasteboard, which is prepared by scraping the wood fibres from timber and chewing them up with saliva. Most curious as a piece of insect-craft



H. Bastin

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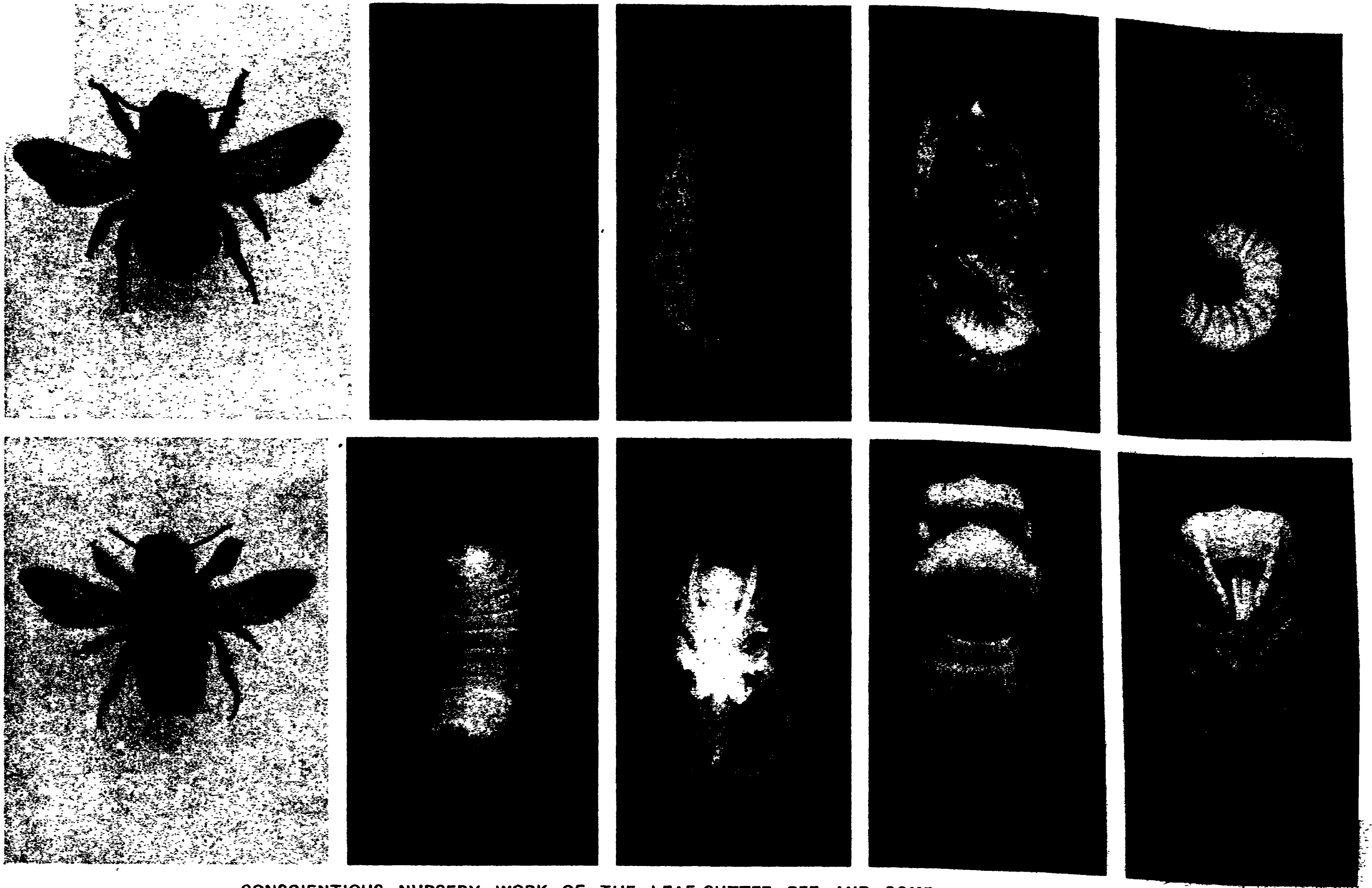
THE LEAF-CUTTER BEE UPHOLSTERS ITS HOME WITH ROSE LEAVES

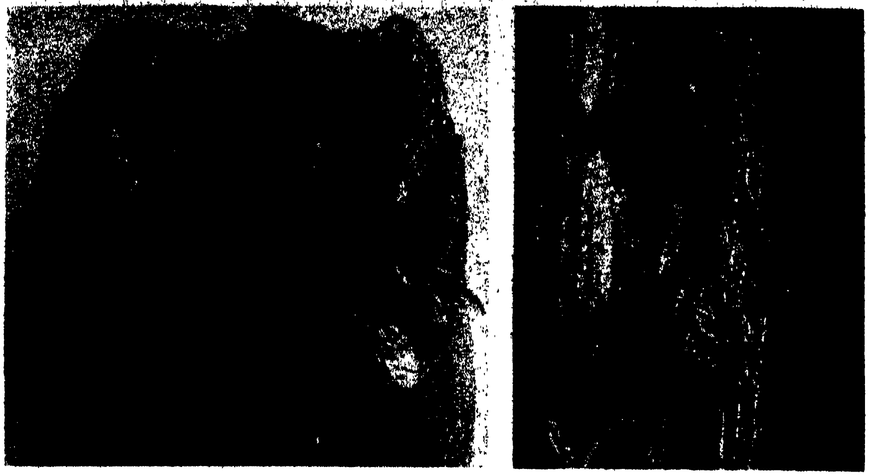
This bee, when it wishes to make a home for itself, finds a piece of rotten wood, easy to bore, and makes a tunnel. Then it flies away to the nearest rose bush and begins to carve out fragments of leaf. For this is the material it uses to line its tunnel. The results to the rose leaves are seen in the top photograph. After cutting (centre left) the required amount the bee carries it, piece by piece (centre right) to its nest, where it constructs cells of the leaf in which to lay its eggs (bottom photograph).



H. Bastin

CONSCIENTIOUS NURSERY WORK OF THE LEAF-CUTTER BEE AND SOME OF ITS RESULTS

From left to right these photographs show (top row) a male leaf-cutter bee; a leaf cell; a cocoon; the cocoon opened at one side to show the developing grub within; and (extreme right) the same grub getting fatter after having eaten nearly all the food supply put bv the parent inside the cocoon. In the bottom row we have the female bee, and next a full-grown grub. Then come three illustrations of the pupa stage, first in the cocoon, then a top view, and lastly the underside. Notice the strange wax-like appearance of these immature creatures which are developing, each one in the dark of its rose-leaf cell in a tiny tunnel in a piece of rotten beam. This series of photographs shows a piece of craftsmanship that few people ever notice.



H. Bastin

is the work of the leaf-cutter bee, which papers the walls of her tiny tunnel in some old willow with rose-leaves. She bites through the leaf-tissue in perfect ovals or accurate circles, folds the fragment precisely in the middle, and flies off with it to her cell. Here she bends it to fit the entrance, and glues it to other leaf-fragments with wax until the entire passage is neatly lined Sometimes as many as a thousand rose-leaf snippings are represented in her strictly utilitarian scheme of decoration.

The carpenter bee, after boring out a gallery for himself in a dead tree, going cleverly with the grain for nearly a couple of feet, mingles the thrown-out sawdust with his saliva and builds partitions and a roof with the mixture, each partition forming a roof to the cell below and a floor to that above. Equally cunning is the wool-carder bee, which constructs a nest of white wool, enclosing wax cells, and this it places in some cavity, an empty snail-shell or even a disused door-lock.. The potter bee digs a hole in the soil, making a chamber at the end of the burrow, stamping the clay well down with her feet.

J. J. Ward

UNTUTORED PROFICIENCY

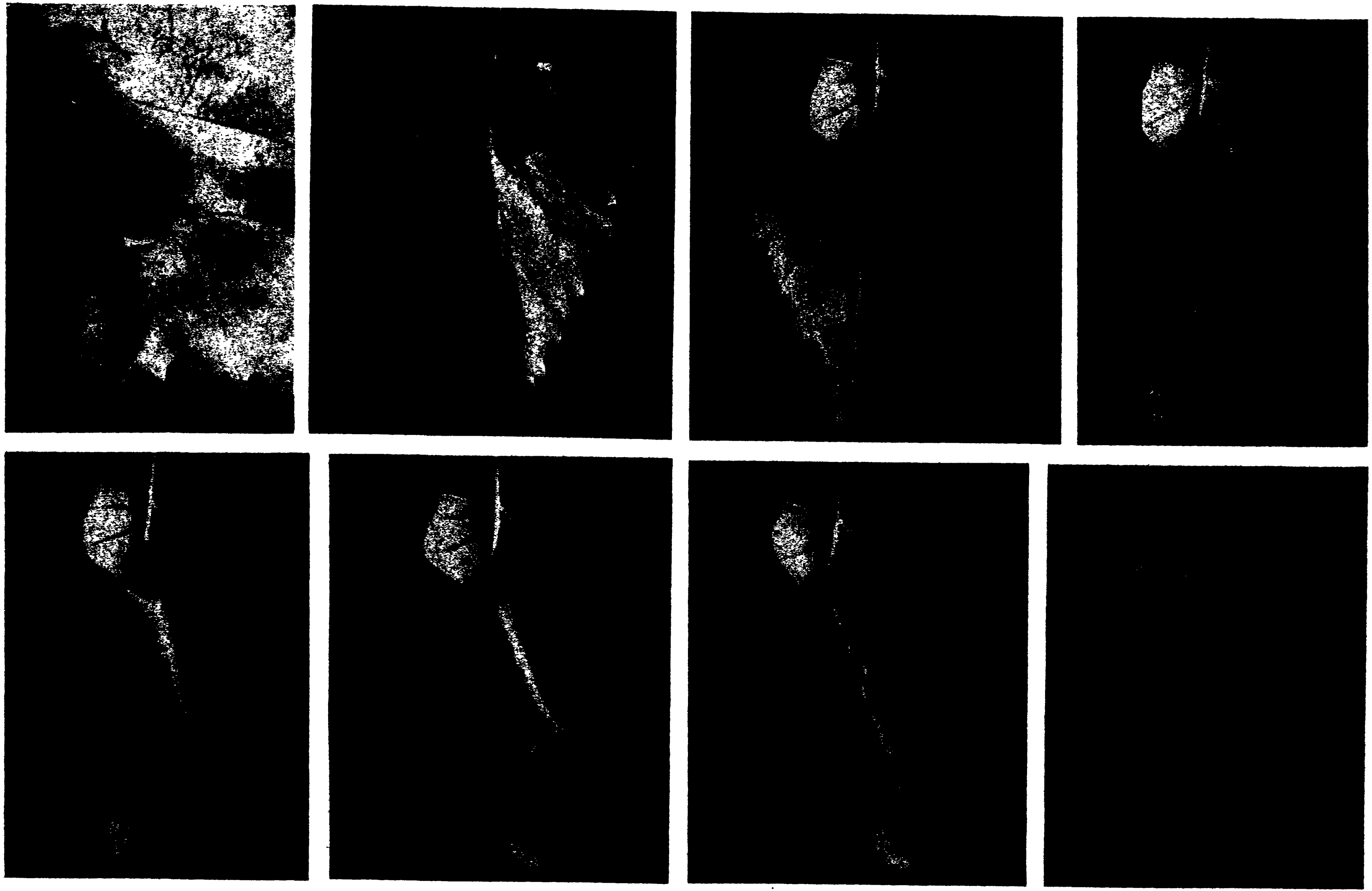
Nobody teaches the spider to spin webs. Our photograph (bottom) shows a young one which is spinning its very first snare after emerging from its egg. Above are (left) a mason bee making a cell, and (right) the cells of sawdust made by a wood-boring bee

No insect surpasses the ubiquitous spider in artistic ingenuity. She is often capable of spinning two distinct kinds of silk, web and cocoon silk, the latter of which is actually capable of being woven into fabric. Of course there are many varieties of snare in the spider world. One British spinner constructs a trap of but four spokes, from which she hangs by a thread, awaiting her prey. When this appears, she releases her hold on the line, when the spokes fly outward and the insect is caught among them.

But the lace-weaver spider is a much more elaborate and conscious artist that the common spinner. Her foundational sheet-webs are much the same as those of her humbler sister, but across these run a number of fine, wavy bands which give the product a highly decorative effect. She is provided for this work with a special apparatus known as a cribellum, which consists of a plate situated in front of the foremost pair of feet, and perforated with a number of very fine holes. The silk produced from these is corded as it is spun and distributed into the lacy fabric of the web by means of extraordinarily fine combs situated in the hind legs of the female. The raft spider collects a few dead leaves, weaves them with silk into a miniature raft and floats over the surface of the water, an arachnian pirate to capture unwary passing insects.

Among the reptiles craftsmanship is not so rare as might be expected. The American gopher-tortoise is an expert burrower, which lines its sand-nest with fir branches, and the European pond tortoise is no mean engineer. She first moistens the soil with water to render it easily worked, and then, employing her pointed tail as a borer, makes a hole in the ground. This she enlarges with her powerful hind legs, laying her eggs within the cavity, and throwing her body on the loose soil with which she has covered the eggs until it is stamped down flat. The manner in which the Brazilian tree-frog constructs its nurseries of mud verges on the human, and observers have written of the extraordinary man-like way in which it uses its forepaws to smooth the exterior of those structures, "working like a mason with his trowel," and levelling the floor with its stomach.

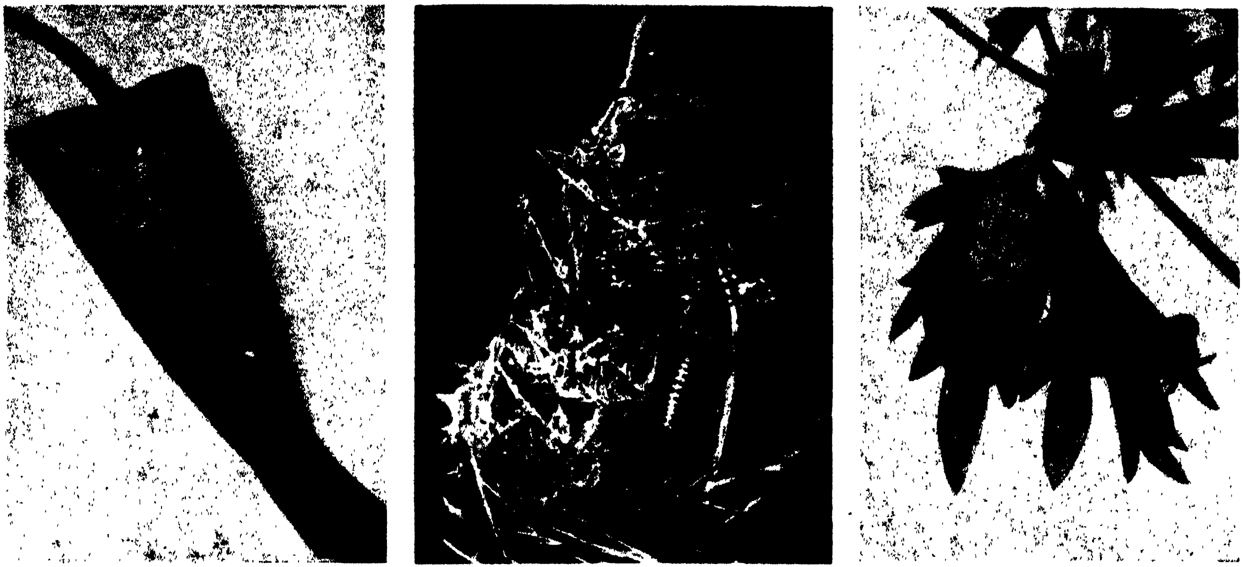
The ingenuity of the finny tribe is confined mainly to nest-building, usually of a primitive kind. Perhaps the most ingenious is that of the goby, which inhabits sea pools and selects for its nest the shell of a limpet or crab, turning it so that it serves the purpose of a tent. The parents work their way out of this shelter through the sand, leaving a round entrance, over which the male lays a filmy secretion from his body



H. Bastin

BIRCH-WEEVIL MAKING A PURSE OUT OF A LEAF IN WHICH TO HIDE ITS EGGS

For the purpose of making a safe deposit for its eggs the birch-weevil seeks out a birch leaf and, towards the base, makes two cuts—each shaped like an " S "—one on either side of the midrib of the leaf (top left). The other photographs in the upper row show, in turn, the next stages. The weevil begins to roll up the leaf on one side towards the midrib. In the lower photographs we see—from left to right—how the egg case is completed. The other side of the leaf is now rolled up and the weevil disappears inside the purse thus formed. Then it tightens up the folds, tightens them again, and, finally, when all is accomplished, takes a rest from its tremendous task in the uncut part of the leaf.



M H Crawford

J. J. Ward & W. S. Berridge

WONDERFUL NURSERY BOXES IN WHICH SOME CATERPILLARS GROW UP

On the left is a lilac leaf ingeniously sewn together to hide the cocoon in which a caterpillar of the orange moth is developing. The centre photograph shows the nest of the processionary caterpillar. There are about two hundred individuals inside, and when they want food they crawl to the ground and set off in single file, each one joining up behind the next in front until the procession finds a suitable tree to feed on. After eating, the gang comes home as it went. On the right is a cocoon like a paper balloon, made by the larva of the golden plusia moth.

in order to hold the particles of sand together and keep the opening free. In this nest the eggs remain secure, the goby taking up a position near the entrance and waving his fins so that a fresh current of water continually passes over them.

The common stickleback's nest is perhaps as elaborate as any. It brings grass and aquatic weeds from a considerable distance which it carefully lays down on the bed of the stream, interlaced so as to form a neat and compact structure, smooth and rounded inside, but rough and unfinished without. It is held together by a secretion from the male, which acts as a natural mortar.

Among the crustaceans there appears to be little ingenuity, but the mollusca make up for the deficiencies of their greater cousins. Originally naked and defenceless, the molluscs developed shell coverings in which to lie at armoured ease from cunning enemies. The calcium carbonate from which these shells are made is derived from the water in which the marine molluscs dwell, and, as in the case of the piddock, is so strong, that it can be used for burrowing through rock. The piddock is, indeed, responsible for much of our coast erosion, and wherever he is common chalk and limestone cliffs are usually riddled with his galleries, which in the end undermine the cliff-face.

Among the land molluscs one at least has solved the problem of aeronautics. The prickly snail is able to climb trees, but has usually some difficulty in making a descent, so he mounts a leaf which is about to fall, clings firmly to it, and gradually descends as by a parachute.

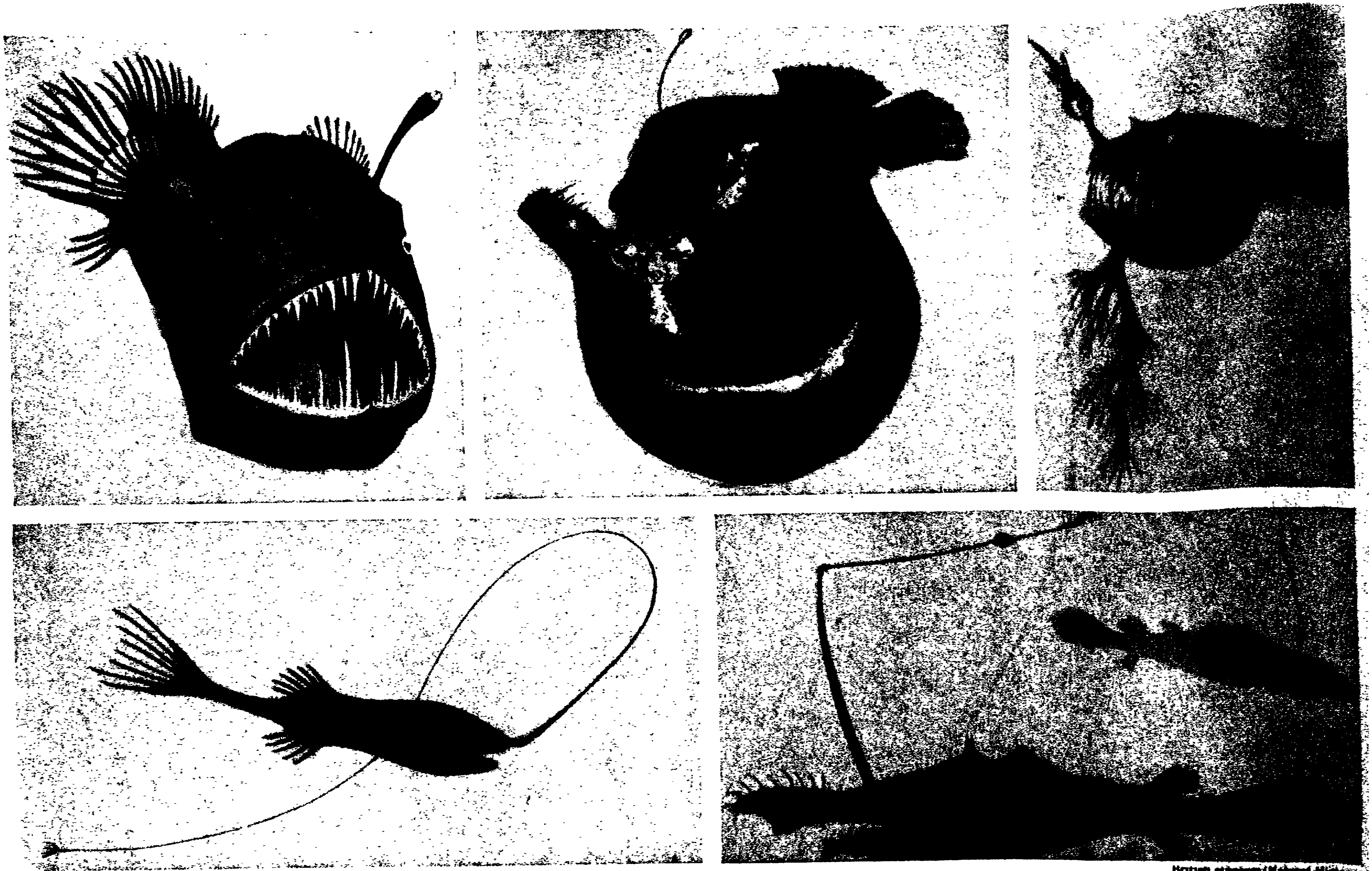
No result of molluscan or, indeed, of animal activity equals the pearl in beauty or symmetry of construction. It is merely a protective secretion thrown out to prevent injury to the mollusc from a foreign body. Any bivalve may produce " pearls " of sorts, and they are by no means confined to the true pearl oyster, which is more of a mussel than an oyster proper.

When a foreign body, such as a grain of sand, introduces itself, or is introduced, within the shell of the oyster, a growth in the lining of the shell is caused. Some authorities believe the irritant agent to be a parasite, although this is doubtful, but in all likelihood the causes of irritation are various. In the Ceylon pearl, for instance, the exciting cause is certainly a tiny worm whose larvae batten on the bivalve. The finest pearls are admittedly those which grow just inside the edge of the shell.

The method of extraction is somewhat nauseous. The oysters are simply left to be eaten by the maggots of a rather nasty species of blow-fly, which in time devours the edible portion. The shells are then washed and the pearls detached from their lining of nacre.

Those little moons of the sea are scarcely more lovely than the nacre from which they come, the beautiful substance known as mother-o'-pearl, that irridescent membrane which is perhaps the most fairy-like element our planet affords. The manufacturers of this substance, both oysters and the humble mussel, have surpassed even man himself in the radiance of their achievements Nacre is composed of the same substance as the pearl itself, but has a rather different purpose, to enable the bivalve to lie smoothly in its flinty house.

But in ingenuity of craftsmanship as well as in beauty of production surely the coral polyp is pre-eminent in the animal world. It has indeed been left to the least of creatures to create forms which vie with the most enchanting of flowers.



British Museum (Natural History)

FISH FREAKS FROM THE SALT SEAS WHICH CATCH THEIR PREY WITH ROD LINE AND BAIT

These angler fishes differ from all other fish in that the foremost spine of the dorsal fin is situated on the head and used as a fishing line. Some of the fish live at the bottom in fairly shallow water while one group, that of the Ceratioids, live in mid water in the open sea at depths of from 250 to 1,000 fathoms. Here we have *Giganticus* (bottom left) which has a fishing rod and line much longer than its body; and (bottom right) *Lasiognathus* with a rod like a broken trolley-arm on a tram-car. Notice the amazing contour of the body. Above we have (left) *Melanocetus*; (centre) an angler fish photographed to show the astonishing distension of the stomach possible to these creatures—it has swallowed a fish larger than itself; and (right) *Linophryne* which is all head.

Chapter XCVII

Nature's Strange Show of Freaks

By W. S. Berridge

Author of "Marvels of Animal Life"

The old adage that "beauty is but skin deep" is certainly true, but considering that what one person may admire another may regard with indifference, it is quite obvious there is no true standard as to what really does constitute the beautiful. In a like manner what constitutes the ungainly and grotesque cannot be clearly defined, and is largely a matter of opinion, for some of us may appreciate that which may appear quite repulsive to others.

Such being the case, we feel we may be acting rather rashly in selecting certain members of the animal kingdom and placing them under the heading of "Nature's Freaks," but, be that as it may, the fact remains that some creatures are so remarkable-looking as to justify fully such an epithet.

Among the monkeys there are quite a number that arrest attention on account of their extraordinary appearance. In the group known as guenons there are two kinds, often spoken of as putty-nosed monkeys, that have a large, triangular mark on the end of the nose that looks like a dab of paint; another species is adorned with a pale-blue line across the upper lip suggestive of a moustache; while the Diana monkey grows a long pointed beard of white hair, which it has been known to hold on one side when drinking so as to prevent it from getting at all soiled.

E.N.A

AN APE OF BORNEO

With the long-armed ape of Borneo we seem to come to a case where Nature has laid herself out to fashion a grotesque. But, in reality, of course, these elongated arms have been evolved for a purpose and to meet a need

None of the baboons can be regarded as being blessed with good looks, and the mandrill is certainly the most repulsive-looking of all. In scientific nomenclature it is called "mormon," meaning "spectre," a term that is certainly a very appropriate one to apply to the beast. It possesses a very large head, deep-set eyes, and projecting eyebrows. A crest of hair is present upon the crown of the head, and the chin is furnished with a short, pointed, orange-yellow beard.

But the most astonishing feature in regard to this baboon is to be noted in the large, ribbed swellings on either side of the face, these being blue in colour, and forming a vivid contrast to the bright red lips and nose. This colour scheme is continued on the animal's hind quarters, though in a somewhat modified degree, the red callosities thereon being thinly veiled with pink, heliotrope, azure, and lilac hairs. Owing to its remarkable appearance, an adult mandrill not only proves a great attraction at zoological gardens, but it is also a source of much merriment to the beholder. Indeed, it may well be said that "its face is its fortune."

The snub-nosed monkey and the proboscis monkey must certainly be included among the freaks of Nature. The former, found in Eastern Tibet and China, possesses a small, upturned nose that imparts a most comical appearance to the beast, while the bluish-grey skin of the face is encircled by a band of bright orange hair which also extends to the neck and chest.

The proboscis monkey, which comes from Borneo, goes to the other extreme in nasal development, for its large, drooping nose projects for four or five inches beyond the level of the face, the under surface being flattened, and the nostrils being situated beneath. This monkey, which was first brought to the notice of zoologists in the year 1781 by Baron Wurmb, Dutch Governor of Batavia, attains a length of about two and a half feet, exclusive of the tail, which measures some two feet or more.

Another most remarkable-looking monkey is the South American saki, a heavily-built creature with a large, bushy tail, suggesting the brush of a fox. Its entire face is clothed in short hair of a pale ochre tint, and that of the rest of the animal is jet black—the contrast between the two colours being so great and so clearly defined that the beast looks exactly as if it were wearing a mask In spite of its forbidding appearance, however, this saki monkey is reputed to be of a very inoffensive disposition, a fact that was fully borne out by a specimen exhibited at the London Zoo many years back—the sole individual of its kind ever imported alive to the British Isles.

HEAD OF THE UGLY AARDVARK WITH ITS SPECIALLY ADAPTED SNOUT

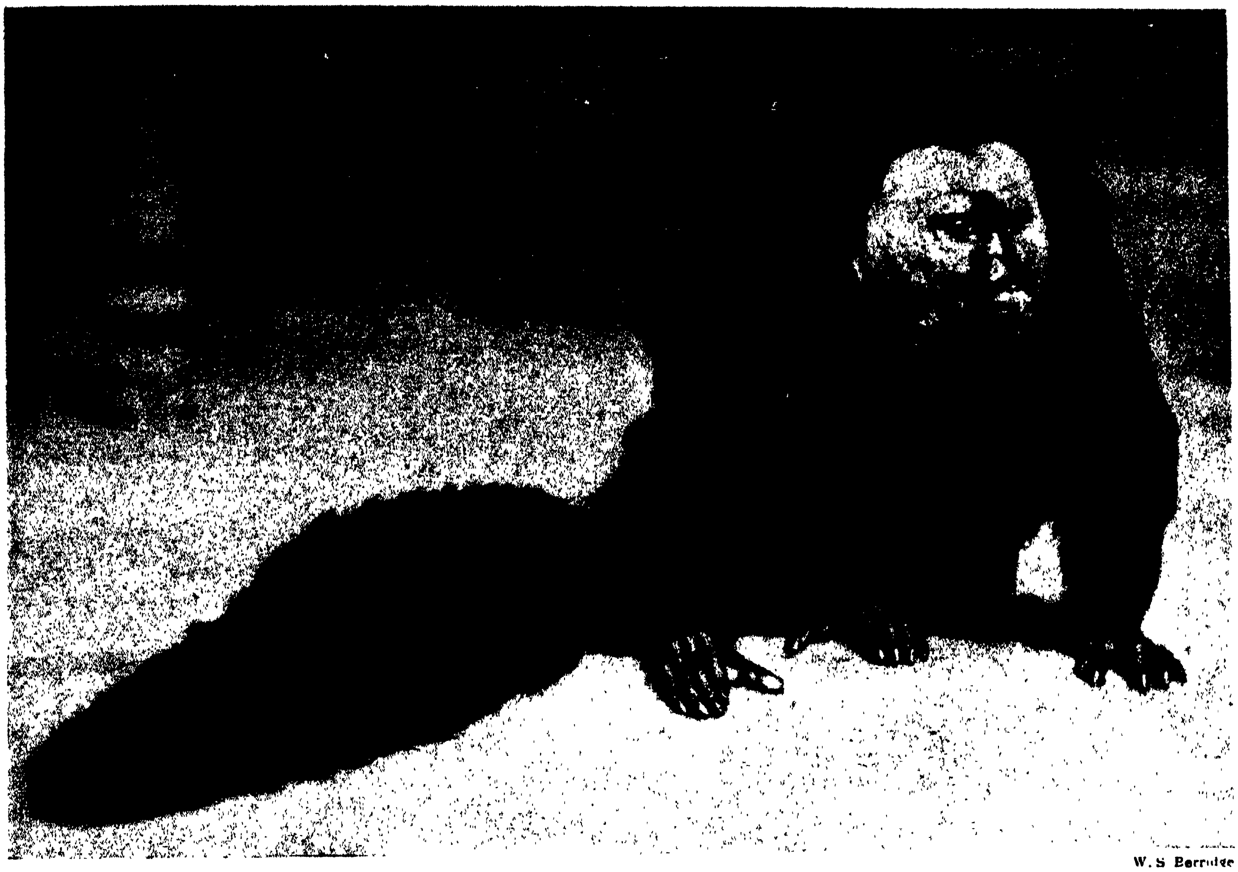
Here we see the head of the aardvark, a Dutch word meaning "earth pig", in the position in which it digs into ant-hills. We see that the head is, in fact, merely the broad end of a very long and specially adapted snout, whose purpose it is to eat up the tasty termites when the strong claws have scratched a hole in the exterior of the nest. Notice the slope of the eye and the way in which the very long ears are laid back. The aardvark is a nocturnal animal, and hails from South Africa.

Closely allied to the typical monkeys are a group ot animals called lemuroids. They rank as the lowest of the primates, and most of them are nocturnal in habits. Among them are to be numbered several peculiar types, the most remarkable being the slow loris, which comes from India, Burma, the Malay States, Siam, Sumatra, Java, and Borneo, the slender loris, found in Southern India and Ceylon; and the tarsier, an inhabitant of Celebes, Borneo, Sumatra, and the Philippine Islands.

The scientific name of the first mentioned is *Nycticebus tardigradus*, the former word meaning "night ape," and the latter "slow step." The name "loris," from the Dutch "loeris," signifies "a clown," while in Malaya the animal is variously called the kokang, kongka, or kukang. By the Bengali natives it is known as the "chirmundi-billi" or bashful cat, and "lajjar banar" or bashful monkey, these names being given to it because of its habit of sleeping with its face tucked in between its knees. The Siamese sailors call the creatures the "ling lom," meaning wind-monkey, and regard the whistling noise it occasionally utters as a sign of approaching rain. They also state that if a live loris be kept on board their sailing vessels, the craft will never be becalmed. But the most remarkable belief held in regard to this little beast is that if a man buries the body of one under the threshold of an enemy, the latter will unconsciously be forced to commit a crime, a somewhat roundabout way of getting him into trouble.

As implied by its name, the slender loris is characterised by the extreme slenderness of its body and limbs, a feature so pronounced that the animal almost looks as if it were suffering from some wasting disease. The Tamils call it "thavangu" or thin bodied, an expression they also employ when alluding to a deformed or very thin person. The animal is very deliberate in all its movements, and in Ceylon it often goes by the name of "Ceylon sloth." Like the slow loris it has no tail, and its enormous eyes are remarkable for their close proximity to one another. Sir Emerson Tennent tells us that the "large and intense eyes of the loris have attracted the attention of the Singhalese, who capture the creature for the purpose of extracting them as charms and love-potions, and this they are said to effect by holding the little animal to the fire till the eyeballs burst."

The tarsier receives its name because of the great length of the upper bones of its ankles. It is the rarest of the lemuroids, and no living example has ever been imported into Europe. About the size of our brown squirrel, it reveals several peculiarities



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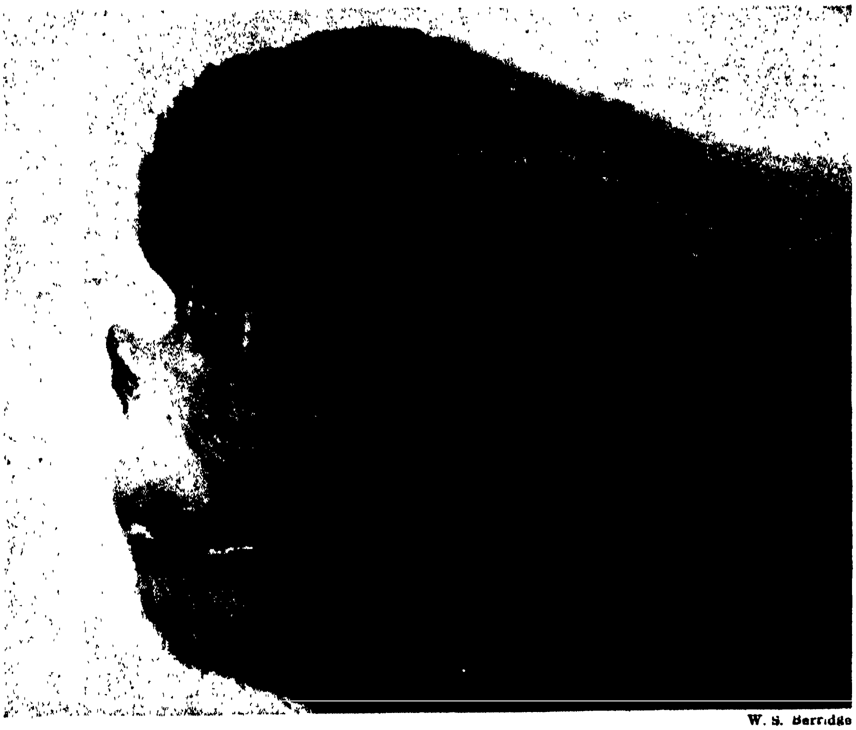
not found in other creatures. The extremity of each finger, for instance, terminates in a large, rounded disk that acts as a sucker and enables the animal to adhere to any object upon which it may alight. When moving about the dense bamboo jungle amidst which it dwells, it jumps from one stem to another with a rapidity so great that the eye can scarcely discern its passage, its leaping power being likened to that of a flea. The large eyes are rendered exceptionally conspicuous owing to the smallness of the face and jaws, while the long tail is remarkable because it is quite devoid of fur, except at the extreme base and tip.

Pigs have never been noted for their beauty, and it is not surprising to find that among this group is to be found an animal that has earned the reputation of being the ugliest beast on earth. Known as the



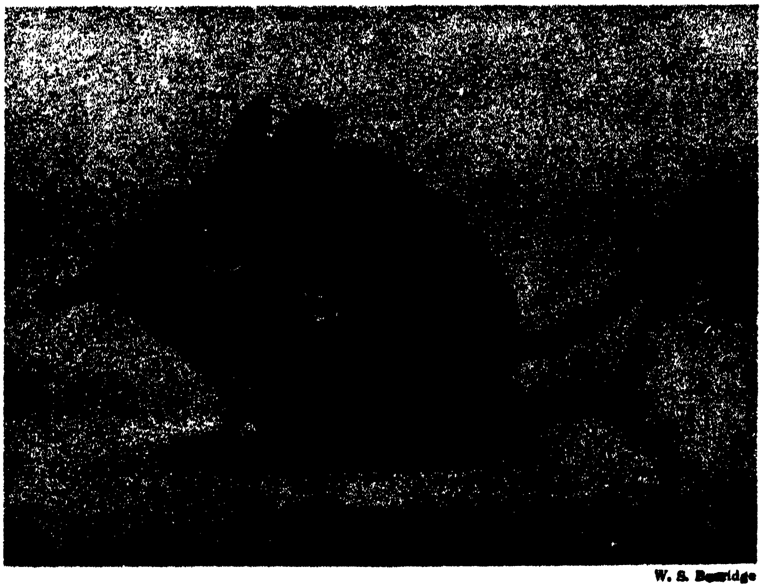
W. S. Berridge

EXTRAORDINARY MONKEYS OF NEW WORLD AND OLD

The snub-nosed monkey from China and Eastern Tibet (bottom) has a face which is mostly upper lip, while its nose is a mere isolated lump. A fringe of orange-coloured hair surrounds the face, which is of a grey-blue tint. The white-headed saki (top) has a face shockingly like that of a stout, elderly man. It is a native of South America, haunting the Amazon basin.

wart-hog, it is a heavily-built creature that, when fully grown, stands about thirty inches in height at the shoulder, and weighs up to 230 pounds. Its large head terminates in a broad, flattened snout, and wart-like protuberances are present upon the face, one arising below and to one side of each eye, and two others being situated lower down. Except for a mane of long, bristly hair upon the neck and back, the skin is otherwise practically naked.

Wart-hogs, of which there are two species, are found in Africa. They never congregate in large herds, the males leading a solitary life throughout the greater part of the year, and the females and young ones congregating in small parties. They usually confine their activities to the night time, when they go forth to seek their food, which consists chiefly of roots. During the day they lie concealed among bushes or thick undergrowth, though not infrequently they will make their headquarters in the deserted burrow ot an aard-vark, or antbear. It has been observed that when the animals enter their subterranean home they go in backwards so as to be prepared to quit at a moment's notice, while, moreover, when leaving, they often do not walk forth in a normal manner, but as soon as they emerge turn a somersault and land on the ground just above and behind the entrance to their underground sanctum. Like other pigs, when grubbing for food they will frequently walk upon their inbended wrists to bring their heads near the level of the ground.



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LITTLE FREAKS: ROCK ELEPHANT SHREW & FAT-TAILED MOUSE

As seen thus from the side, the rock elephant shrew (bottom) is almost diamond shaped, so sharp are the contours of its head and back. An extraordinary little nose juts out from its head like the peg of a top. The fat-tailed mouse (top) owes the apparent deformation of its tail to the fact that it stores fat there against the winter.

Another very remarkable member of the wild swine family is the babirussa, a name derived from the Malay words "baba," meaning a pig, and "rusa," a deer. Found in the Islands of Celebes and Boru, it is of a much more slender build than other pigs, and possesses an exceptionally small and narrow head. Both sexes are provided with tusks, those of the female, however, being quite small. But in the adult males they are developed in the most extraordinary manner, the upper pair not protruding from the sides of the mouth but actually piercing right through the flesh and skin in the middle of the face, at a point situated somewhere between the eyes and the end of the snout.

Occasionally attaining a length ot as much as seventeen inches, these tusks continue to grow throughout the life of their owner, the extremities bending sharply backwards, and not infrequently touching the forehead. Why they should assume such a curious formation is difficult to explain, for they can be ot little use as weapons. A suggestion has been put forward that they serve as a protection to the eyes when the animal is forcing its way through the dense forests of its habitat, but although they undoubtedly do act as such, the question naturally

WART HOG, A TUSKED AND SNOUTED FREAK OF THE AFRICAN WILD

With grotesquely curving tusks, the hideous warts below the eyes which give this wild hog its name, and a draggle of coarse hair on head and back, this animal is indeed one of Nature's freaks. The skin is as cracked as dried mud and the typical pig eyes, small and evil-shining, add to the generally grotesque and repulsive mien. The warts below the eyes may serve to protect them during the battles between the boars

To face page 1080

arises as to why the females also are not endowed in a similar manner.

In olden days it was believed that the animal employed its curved upper tusks for the purpose of hooking itself to a branch of a tree when retiring to rest, but it is hardly necessary to state that this quaint conception is not based upon fact. The babirussa dwells in the neighbourhood of rivers and lakes, and feeds chiefly upon aquatic vegetation. It takes freely to the water and swims with facility, a fact of special interest in view of the common supposition that pigs cannot swim, but only cut their throats with their sharp hoofs whilst in the act of striking out and making the attempt

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BRINDLED GNU AND A MEXICAN HAIRLESS DOG

The gnu of the South African veldt is a freak in that it seems to be in doubt as to whether it ought to belong to the horse, the ox, or the antelope families. The nostrils are noticeably weird in shape, as is, indeed, the whole head. The upper illustration is of one of the absurd-looking Mexican hairless terriers.

Although babirussas are rarely seen outside their native home, they have been exhibited at the London Zoo in the past, and young ones have been born there—the babies, unlike those of the majority of wild pigs, being unstriped at birth, and there never being more than two in a litter. The animals become quite tame, and in Celebes they are sometimes kept as pets and allowed to roam at their own will about the natives' houses.

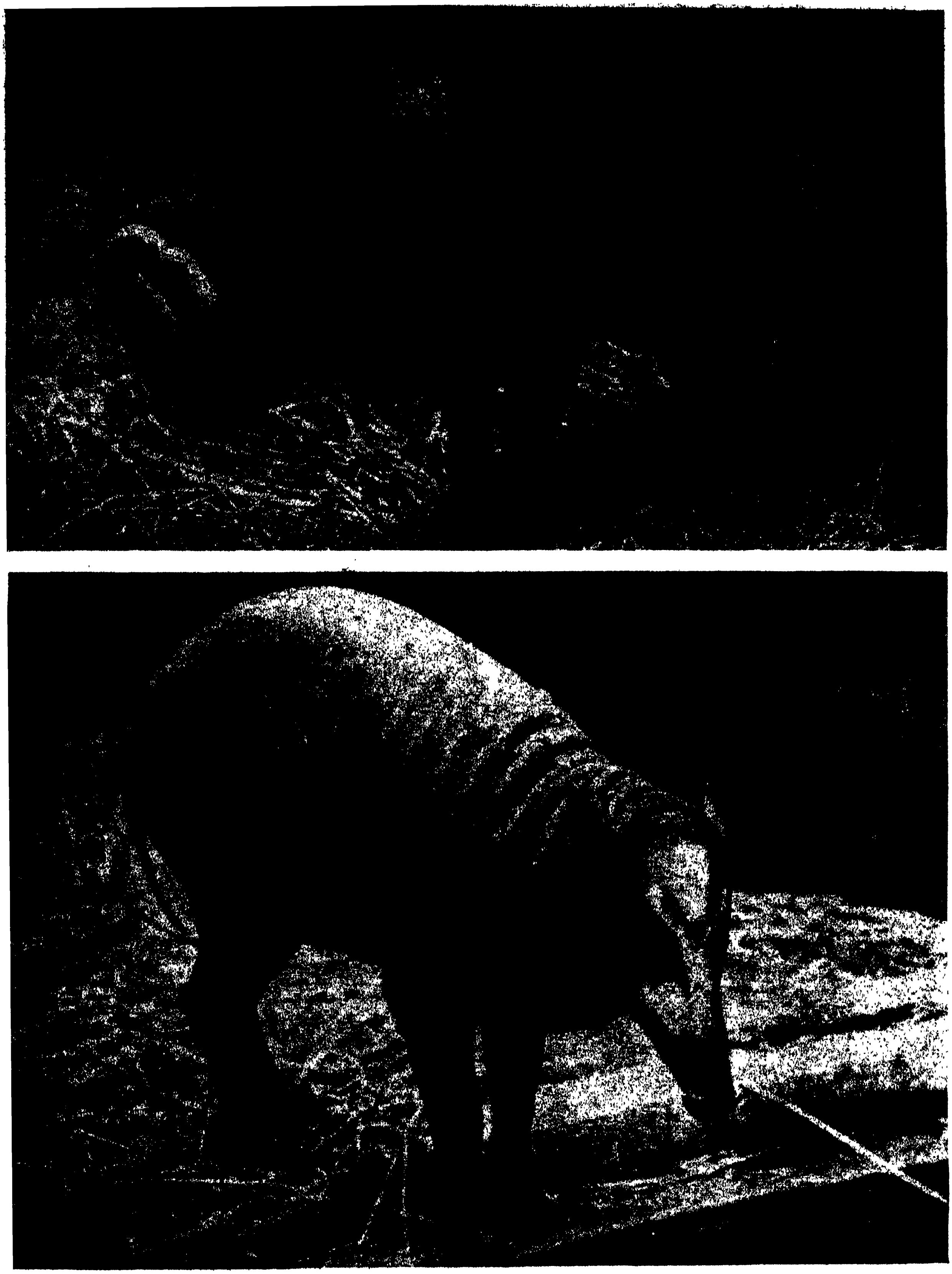
Among the group of animals known as the edentata. so called because they do not possess front teeth, and are sometimes quite toothless, we have in the aard-vark, the sloths, and the ant-eaters some creatures of very grotesque appearance. Also called the ant-bear, or earth-pig, the former is an ugly-looking beast measuring about six feet in length. Its long head terminates in a pig-like snout, and the ears are of enormous size. The thick, stumpy limbs are provided with powerful claws employed for excavating a subterranean home wherein to sleep during the daytime. In spite of its large size, the animal feeds entirely upon ants and termites, of which it laps up enormous quantities with the aid of its long tongue.

Although possibly of a more prepossessing appearance than the aard-vark, the sloths are to be numbered among the curiosities of the animal world. Arboreal in habits, they spend practically the whole of their lives hanging back-downwards from the branches of trees, suspended therefrom by their long, curved claws. On the rare occasions when they do descend to the ground they can only progress by dragging themselves along by clutching on to any inequalities of the surface, such as a stone or the root of a tree, that may lie in their path. They are clothed in thick, coarse, fluted and somewhat brittle hair of a brownish-grey colour, but often the fur assumes a greenish tint owing to the presence of a powdery fungus that grows thereon. Another curious feature in regard to the fur is that it lies in the reverse direction to that of other creatures, so that when the

W. S. Berridge

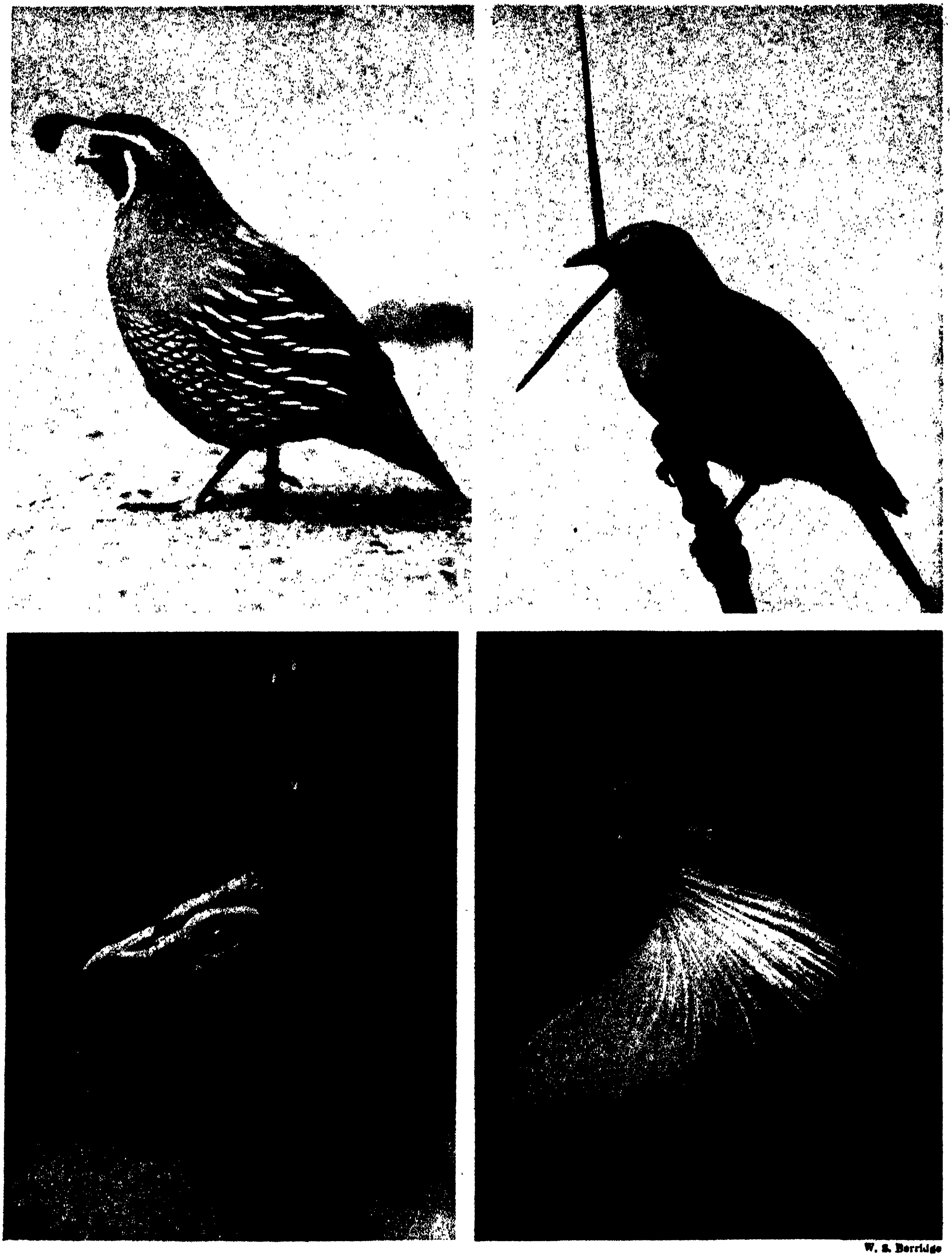
PROECHIDNA AND THE GREAT ANT-EATER THAT BOTH POSSESS PHENOMENAL SNOUTS

From New Guinea comes the strange proechidna, or black-spined porcupine ant-eater (bottom). The epithet " black spined " refers to the spikes which mingle with the hair of its body and can be made out here amid the short, woolly-looking hair which covers it. But the most remarkable thing about the proechidna is that it has a nose like a carrot. This imparts a touch of the bizarre to an already weird animal. The great ant-eater (top), has abnormal prolongations at both ends, for it has a tail like a vast feather fan.



THE HEIGHT OF UGLINESS AMONG THE PIG FAMILY: BABIRUSSA AND WART-HOG

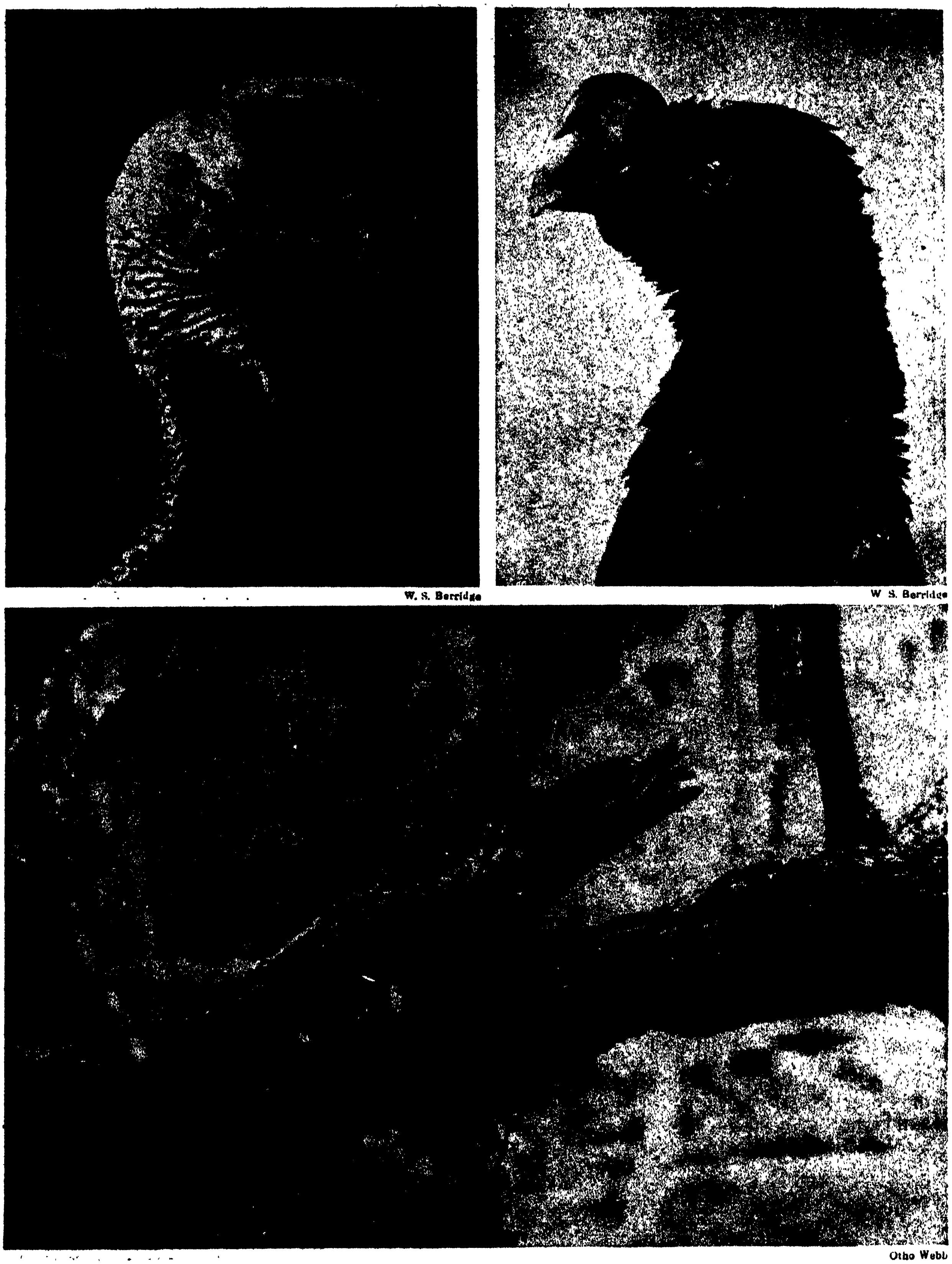
Two Malay words—" baba," meaning a pig, and " rusa," a deer, are the derivatives of the name of the babirussa (bottom), which is found in the great island of Celebes. The babirussa is built on very slender lines for a pig and has a narrow, small head. The specimen seen here seems to have shrunk in its skin, which is very wrinkled about the neck and the shoulders. The upper photograph shows a wart-hog with one of its great curved tusks broken. There is a large lump or " wart " below each eye, and two others lower down.



W. S. Berridge

FOUR BIRDS WITH FREAK ORNAMENTS ON THEIR HEADS

Never did the most wild designer of feminine hats ever beat these birds for queerness of head ornament. The Javan peacock (bottom left) bears a horn like a crest upon its forehead, while the great bustard (bottom right) has a brush of feathers jutting out from under its beak. The Californian quail (top left) has strange plumes standing out from its head and resembling a peak half torn off a cap. Finally, we have the white-headed bell-bird (top right), which has three wattles protruding from it like banderillas from a bull's neck at a bull fight



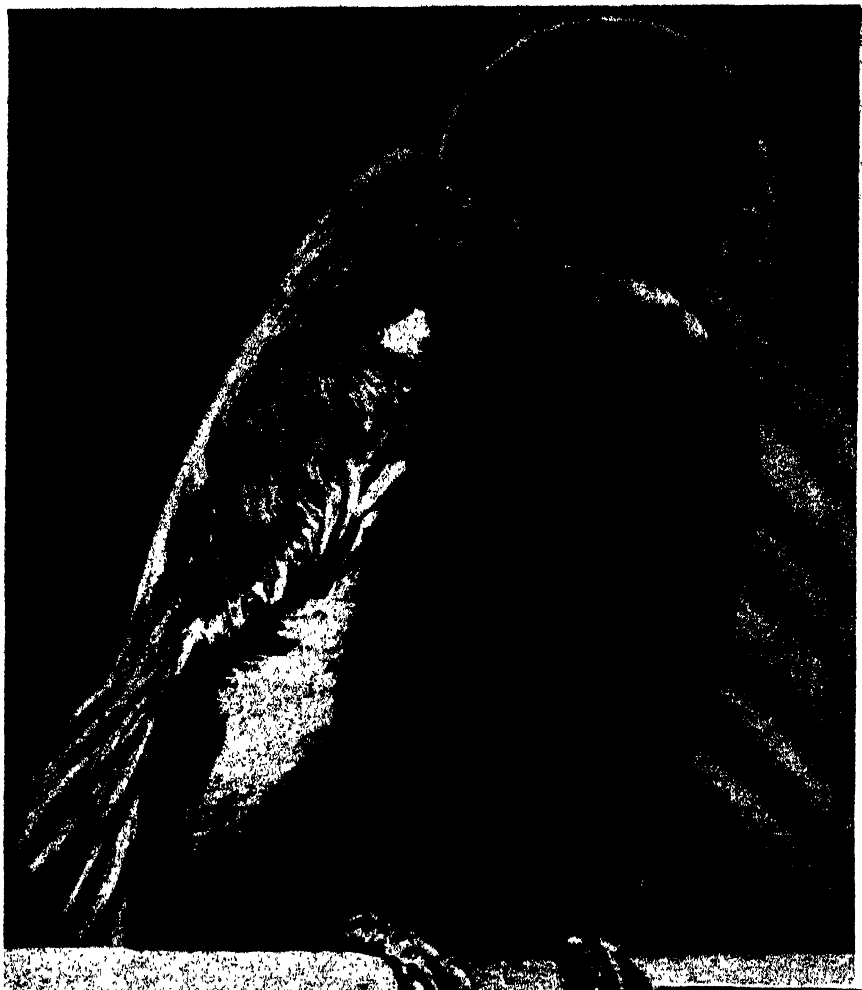
W. S. Berridge

W. S. Berridge

Otho Webb

FROGMOUTH WITH A ONE-WATTLED AND A RAZOR-BILLED CASSOWARY

One of Australia's many strange-looking birds is the frogmouth (bottom), which we here see trying to look as much as possible like a piece of the branch on which it is perched. In page 979 we have another photograph and a description of this interesting and weird-looking bird. The upper photographs are of cassowaries. On the left we have the one-wattled cassowary with the distinguishing triangular lump on its beak, and on the right, a razor-billed cassowary with a very distorted-looking beak.



W. B. Berridge

torrential rains fall the moisture merely drips off instead of soaking through to the skin, as it otherwise would do if the hair grew in a normal manner.

Although all other mammals have but seven vertebrae to the neck, some of the sloths are unique in possessing either more or less than the usual number, Hoffmann's sloth having only six, while the three-toed sloths are provided with nine. The animals feed exclusively upon leaves, the shoots of trees and fruit, but in an old Natural History book we read that they "live onely on aire." Moreover, it is further stated that they have very little mouths and are unable to bite.

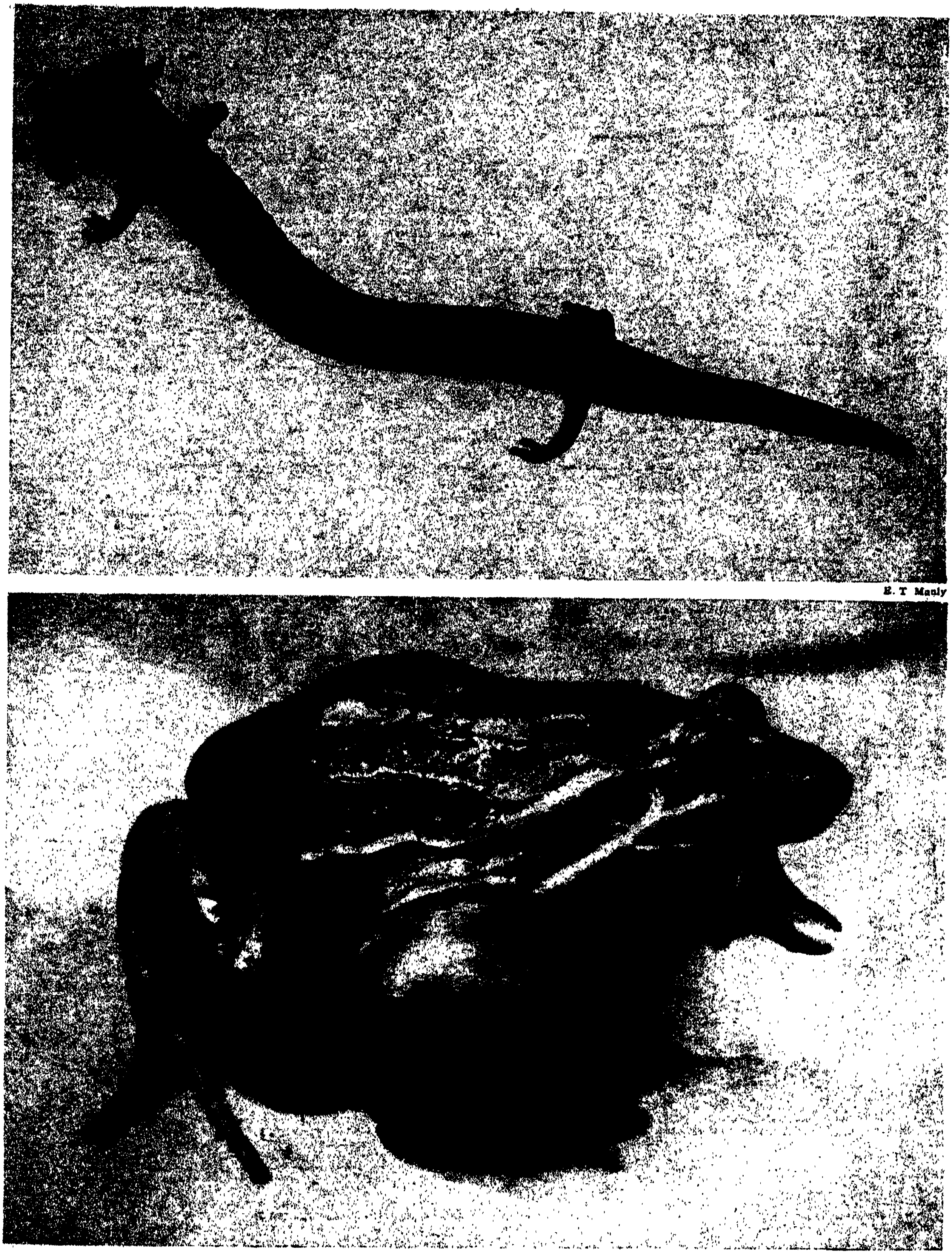
Of the several species of ant-eaters, the great ant-eater is probably the most remarkable. Were it not for the attenuated proportions of its head, its immobile features, and general imbecile appearance, it might be regarded as quite a handsome creature, for its body is clothed with hair that forms an upstanding mane along the top of the neck and body, and the tail is developed into an enormous fan-like appendage, the longest hairs of which measure as much as sixteen inches in length. When sleeping, the animal lies on one side, turns its head inwards, and then throws its tail over itself as if it were a blanket.

Brief mention must be made of the proechidna, an animal of almost freakish appearance, and one that shares with the platypus the unique habit of laying eggs from which its young are hatched. Found in New Guinea, it is sometimes called the black-spined porcupine ant-eater or the three-toed echidna; but although normally possessing but three toes to each foot, the number appears to vary in different individuals, one specimen having been recorded with five claws on each of its fore feet and four on each of the hinder ones. Like the great ant-eater, the proechidna possesses a very elongated and slender snout, at the extremity of which is situated a tiny mouth It has no teeth, but

G. A. Hesse

BIZARRE BIRDS, DOMESTIC AND WILD

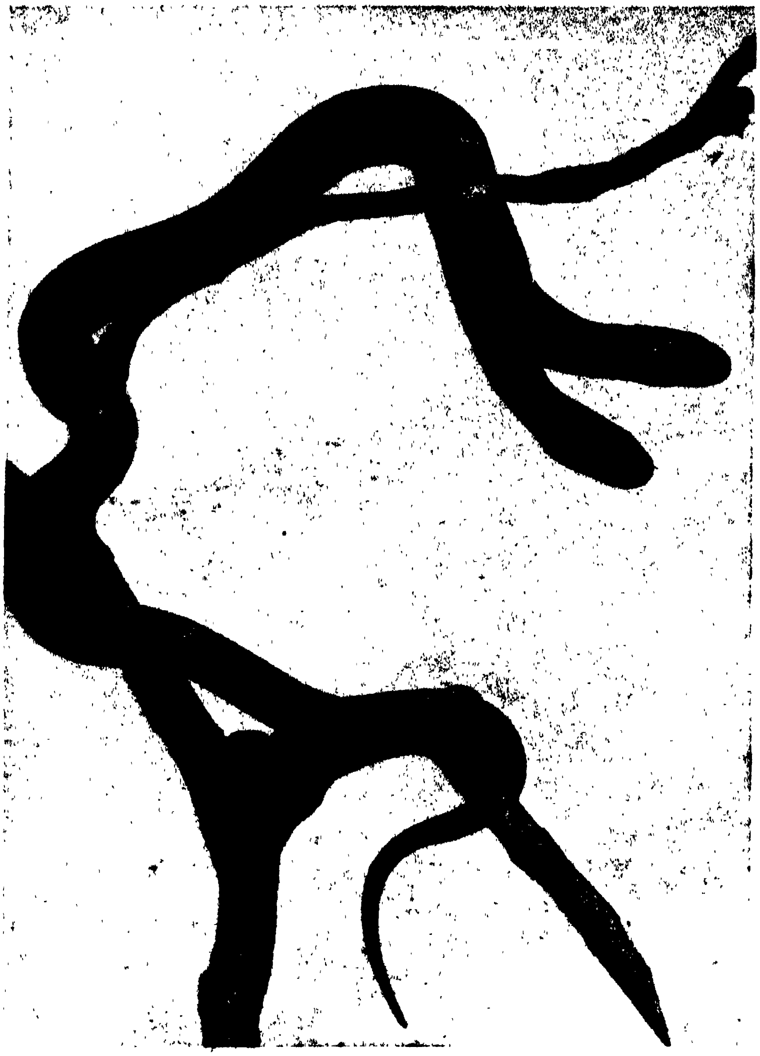
Man has been busy in producing freak birds from the original rock-dove stock, and, as a result, we have such queer pigeons as the tumblers and fantails, a specimen of the latter appearing in the lower photograph. Above is a male cock-of-the-rock.



E. T Manly

OCELLATED BLADDER FROG AND AN OLM FROM THE SUBTERRANEAN WATERS

In the lower photograph is an ocellated bladder frog with immensely fat forelegs, while the upper photograph is of the strange creature called the olm. It is found in the dark waters of certain caves in Dalmatia where no light penetrates, and its skin is consequently white and the eyes covered by skin. When exposed to the light, however, colour appears, and, in certain circumstances, the eyes appear too. It has four little legs, the front pair possessing fingers which, however, have lost the ability to clutch

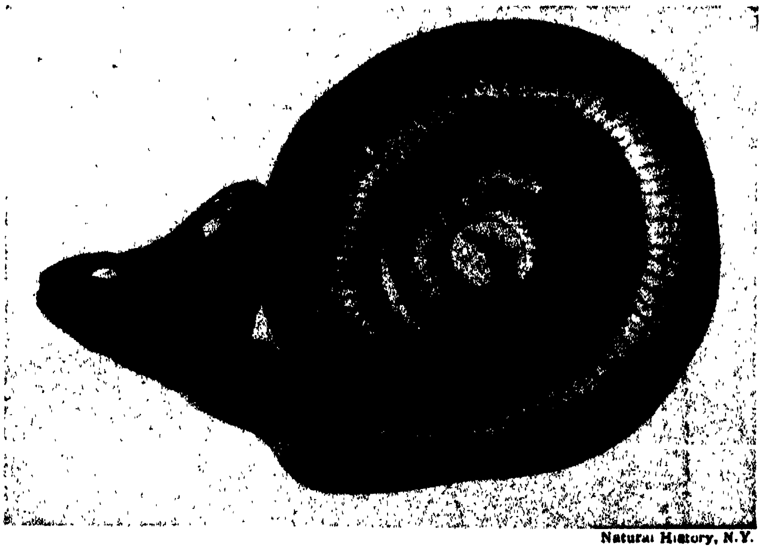


employs its worm-like tongue for gathering up its food. One of these animals is housed at the London Zoo, where it has been for quite a number of years, but as it is nocturnal in habits and lies hidden within its sleeping-box during the hours the Gardens are open to the public, very few people have ever seen it, or even know of its existence.

PASSING to the birds, although the vast majority of them can only be described as beautiful, a few prove an exception to the rule. The shoebill or whale-headed heron, for instance, is a creature that one might expect to envisage in a nightmare rather than in the flesh, its enormous beak, terminating in a sharp, hooked claw, imparting to it a most weird appearance. It lives amidst the swamps of the White Nile, but is nowhere plentiful. Unlike other marsh-dwelling birds, it is of a very unsociable disposition, for, although several individuals may be seen standing in a comparatively small sheet of water, each one keeps as far as possible away from its fellows. Called by the Arabs "Abu markub" or "Father of a shoe," it is a large, heavily built bird that attains a height of about five feet.

Although spending most of its time wading in the water in search of its food, which consists chiefly of fish, it is well able to fly, and when so doing it arches its neck over its back and rests its cumbersome beak upon its crop. The bird thrives well in captivity, but can hardly be regarded as a desirable pet. The young are clothed in blue-grey down, and their bills resemble those of their parents, though being smaller in proportion. Mr. Petherick records that after two years' experimenting he succeeded in rearing some young ones from eggs placed under domestic hens, but we can well imagine the patient sitters had the surprise of their lives when they first caught a glimpse of their foster-children.

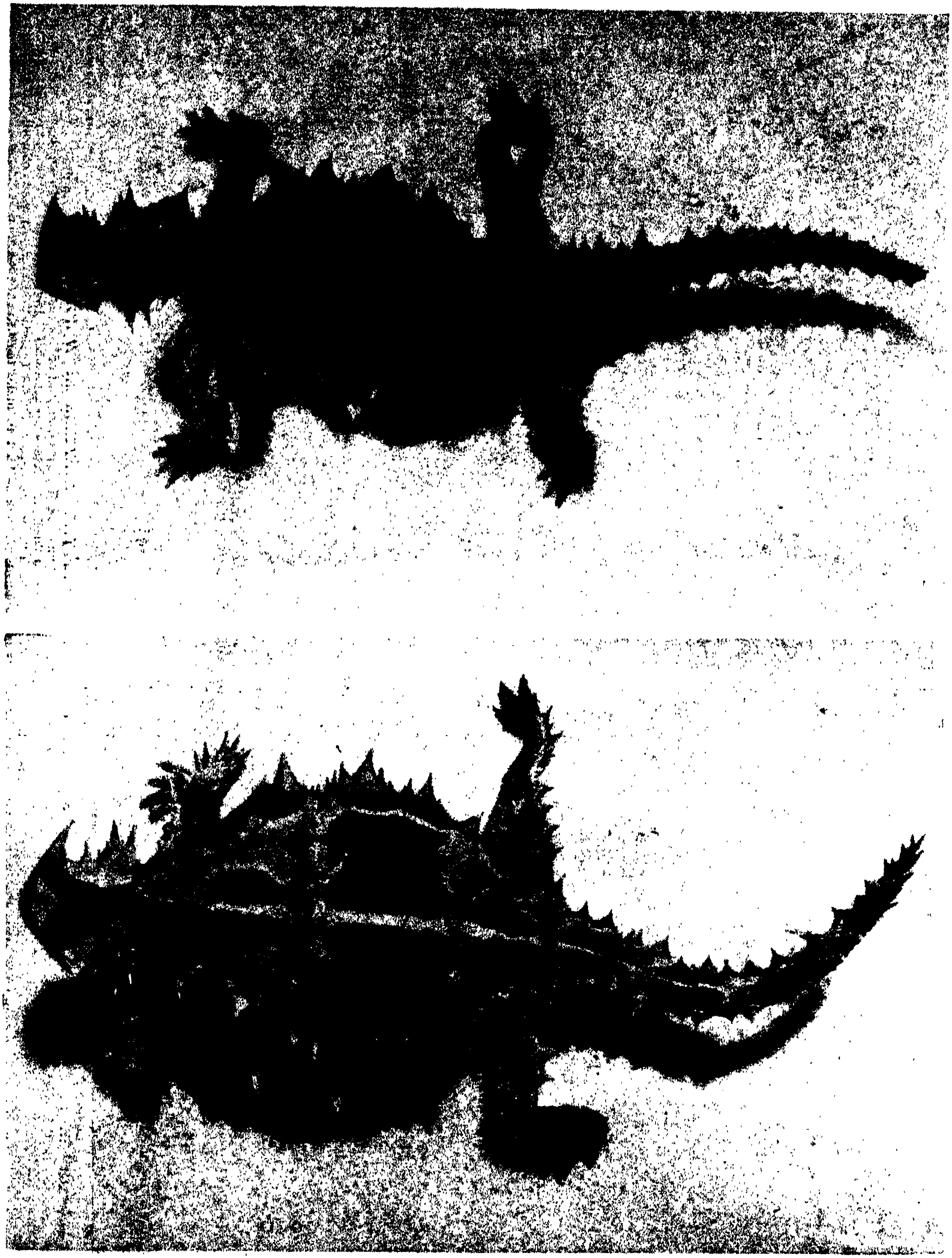
Other birds with abnormal beak development are the boatbills, the hornbills, and the toucans. The boatbill is a moderate sized bird, belonging to the heron family, which comes from South America. Its beak is very large, but the upper mandible, unlike that of the shoebill, is convex in profile instead of concave. The native name for it is "savaku."



Natural History, N.Y.

SNAKE MONSTROSITIES FROM U.S.

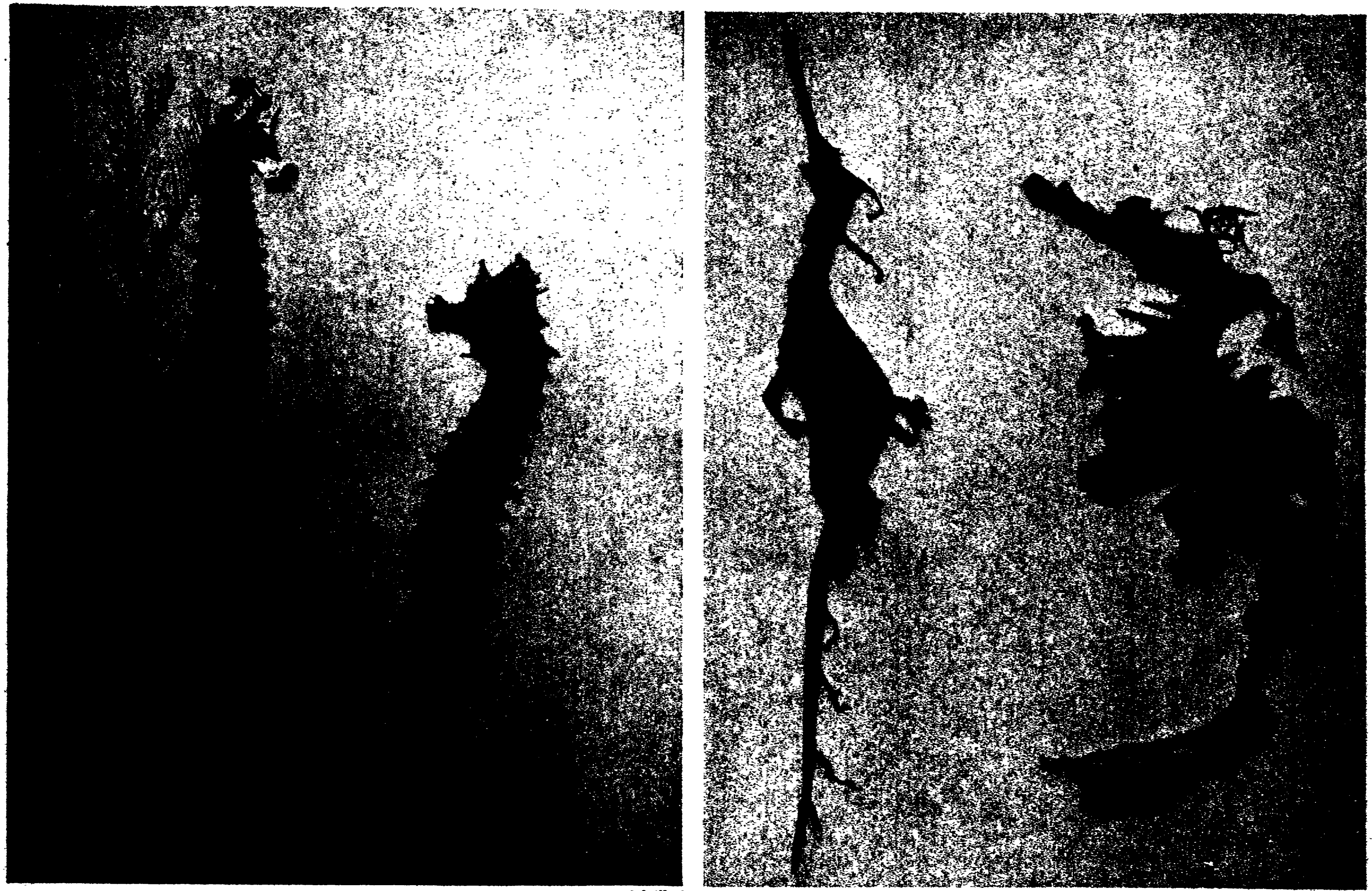
Accidents of birth occasionally produce freaks and here we have two cases, among snakes, where two developing embryos failed to become individualised and a double-headed snake was born. Below is a copperhead and above a milk snake. The latter lived for some months in the New York Zoo. The former was found in the woods of Pennsylvania.



W. Saville Kent

EXTRAORDINARILY SHAPED LIZARDS FROM THE AUSTRALIAN BUSH

Western and southern Australia have, among a varied fauna, these extraordinary lizards which look at a distance more like some kind of prickly-leaf than animals. The spines which cover them are purely defensive and never used for attack. These lizards are found mostly in dry, sandy localities, and their chief food is ants. As ants at times become a nuisance to settlers these lizards often prove a blessing, since the numbers of ants they can capture by lightning movements of their tongues is prodigious. They are known as Thorny Devils.

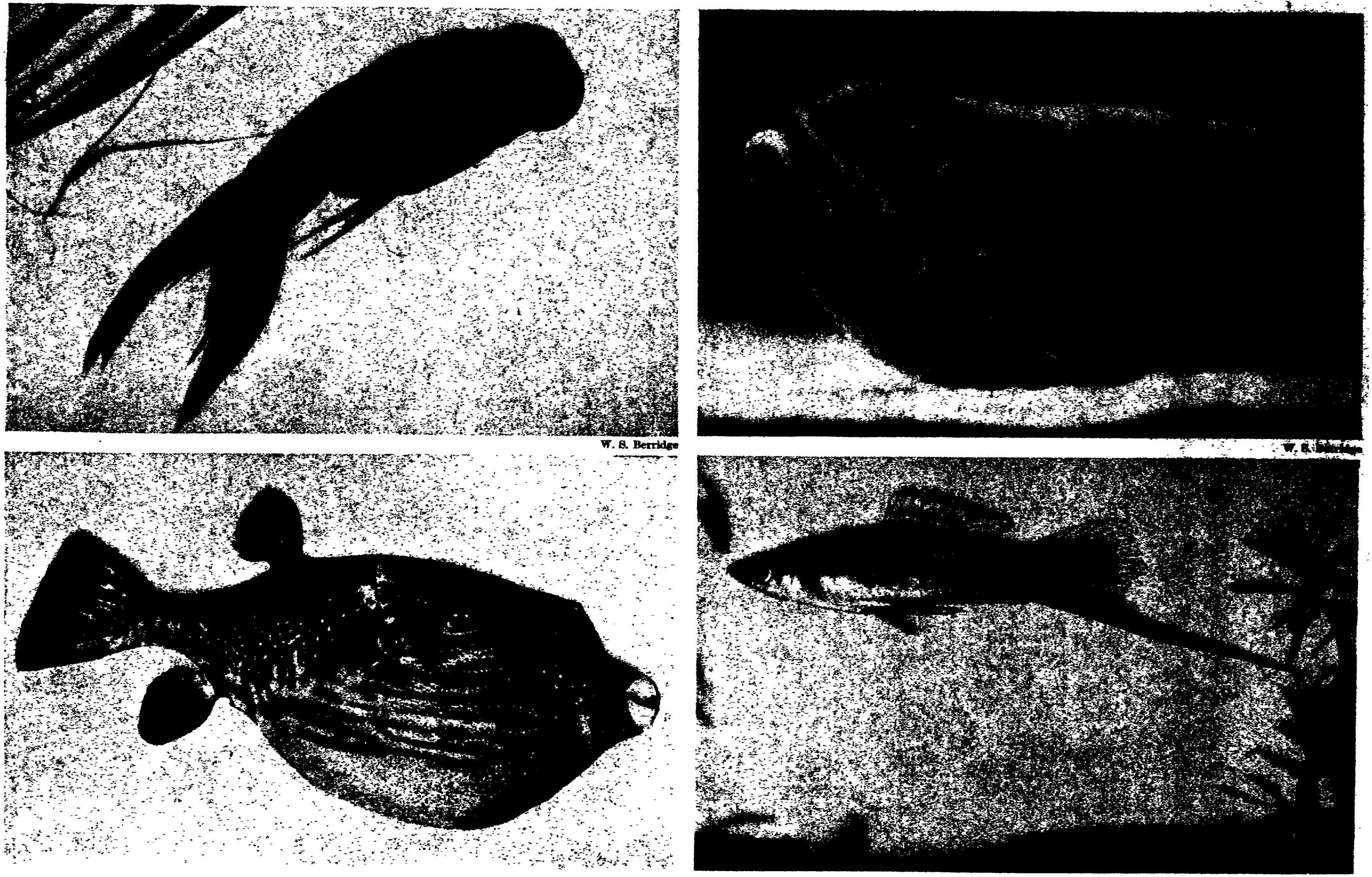


J. J. Ward

Natural History, N.Y.

QUEER FISH WHOSE QUEERNESS HELPS THEM TO HIDE AMONG THE SEAWEEDS IN WHICH THEY LIVE

Among fish the sea-horses (left) have evolved a most interesting abnormality which is responsible for their popular name. The head, instead of being in line with the spine, as in most fish, is bent at right-angles to it, thus giving the little creature a horse-like air. Even more, perhaps, it reminds one of a " knight " in a set of chessmen. The tail lacks the characteristic fin of other fishes and instead of being used for swimming is prehensile and coils round the stems of the seaweeds among which the little sea-horse lives. The sea-dragon (right) which comes from Australian waters, has the contours of its body remarkably broken up by various spiny processes which all tend to make the fish inconspicuous.

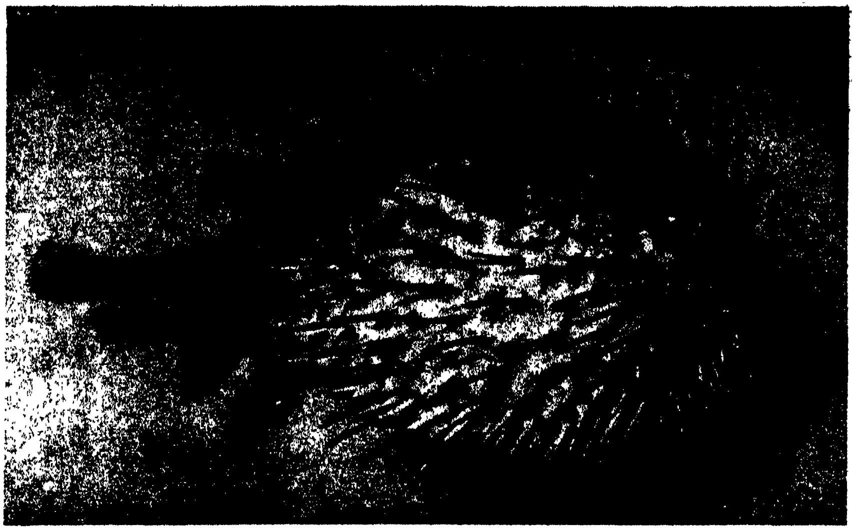


W. S. Berridge

W. S. Berridge

QUARTETTE OF QUAINT SEA CREATURES FROM NATURE'S MENAGERIE OF FREAKS

Nature seems to become most extravagant in fancy where sea creatures are concerned, for the oceans continually yield a fresh crop of marvels to those who seek them. The globe fish (bottom left) and the sword-tail (bottom right) are a pair of marvels such as would have graced any old-fashioned freak show. The sword-tail is a small fresh-water fish of Mexico, and the specimen here is the male of the species, which has a very elongated tail. The sword-tail is viviparous. In the upper left-hand photograph is an example of the telescope-eyed goldfish. We have a side view in this photograph, and the eye is about as large as the rest of the head. The greater weaver (top right) has its mouth in a vertical instead of a horizontal position, more usual with fish.



W. S. Berridge

GLOBE FISH OF THE EXPANDING AND PRICKLY SKIN

While the globe fish or puffer, of which there are a great many varieties, look surprising creatures in the ordinary way, they can make themselves more astonishing still by filling themselves with either water or air so that the skin is stretched tight and numerous spikes and bristles become erect. This is a safety device. Some species are very poisonous.

It is, however, the hornbills that attain the greatest development of the bill, for, besides being of enormous size, it is often surmounted by a large casque. But this structure is not so heavy as it looks, for the greater part is of a cellular nature, although that of the helmeted hornbill proves an exception to the rule inasmuch as it is solid. Indeed, the substance of the casque of the latter bird is of such a close texture as to look like ivory, and it is interesting to note that the Chinese employ the substance as a medium upon which to execute their carvings.

Of the sixty or more different species of hornbills, the largest is the great Indian hornbill, or homrai, which measures about five feet in length from the tip of its beak to the end of its tail; while next in size is the rhinoceros hornbill, a bird that receives its name from the fact that the front part of its large casque terminates in an upturned protuberance suggesting the horn of a rhinoceros. The ground hornbills, of which there are two kinds, are curious for the prominent eyelashes they possess. The Boers call the South African species by the name of "bromvogel." The kaffirs believe that if one of the birds be killed rain will afterwards fall for a lengthy period, consequently, during times of drought it is the custom to throw the carcase of a captured individual into the river-bed so as to bring about the longed-for return of the waters.

THE toucans have aptly been described as "birds behind beaks." Their bills are often almost as long as their bodies, and are invariably decorated with bright colours That of the toco toucan is of a deep orange tint, with large, black, oval spots near the extremity; while yellow, green, red, blue, and black are the prevailing tints in those of other species. To add a further degree of distinction to these avian grotesques, gaudy colours are often displayed upon the throat, breast, and tail. Toucans feed chiefly upon fruit, but they will readily devour any grubs, small birds or reptiles that may come within their reach.

With the adjutant storks we come to some birds that look as if they were suffering from a chronic state of depression. They will stand motionless for lengthy periods, their heads sunk back upon their shoulders, and an expression of utter boredom illuminating their countenances. Perhaps the only time when they assume an air of dignity is when they walk, their measured stride as they slowly proceed on their journey and their resemblance to a military figure on parade, giving rise to their name. Found in India and Africa, they are very efficient scavengers, and in the former country they will not hesitate to enter the large towns to feed upon the filth and garbage that litters the streets.

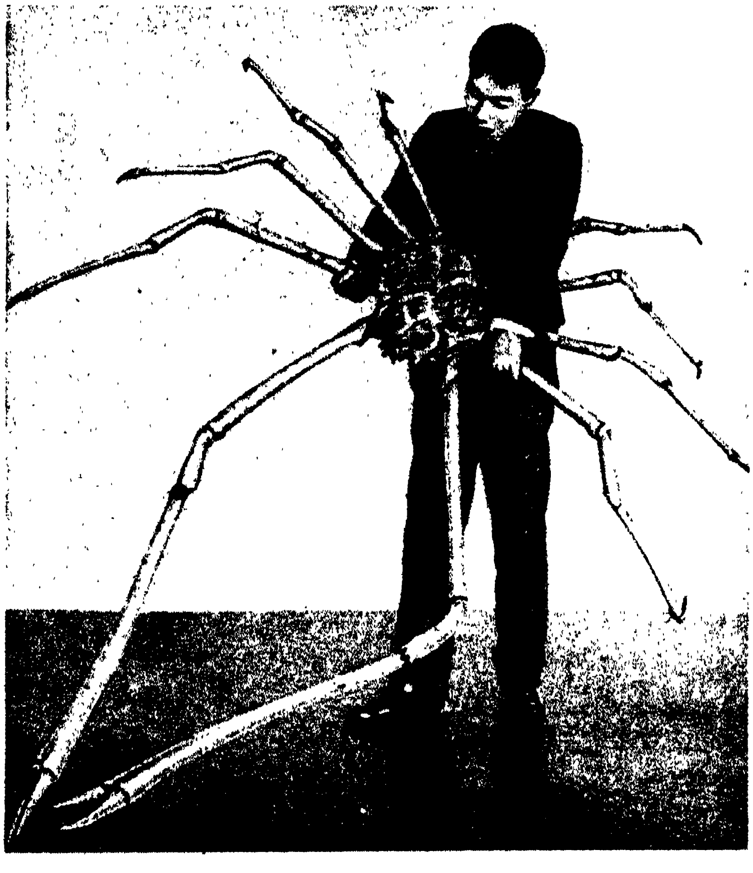
There are quite a number of birds with curious embellishments of the beak. In the comb duck, or black-backed goose as it is also called, the male possesses a large, fleshy prominence that arises abruptly from the upper mandible; the globose curassow has a large, bright yellow, rounded knob in a similar situation; while the male rough-billed pelican grows a thin, erectile, horny excrescence thereon during the mating season.

Other birds reveal peculiarities by the presence of wattles or fleshy growths upon the head. The snowy bell-bird, for instance, possesses a long, sparsely-feathered, rod-like wattle situated at the base of the upper mandible, and this can be erected at will; while the white-headed bell-bird has three of these curious appendages, one on the upper part of the beak, and one on either side at the corner of the mouth. Then we have the umbrella bird, which receives its name from the large crest upon the top of its head, the elevated feathers thereof curving outwards and downwards at their extremities, thereby forming an umbrella-like shield extending from the back of the head to the tip of the beak. But in addition to this curious decoration, the bird also has a long, pendant, bib-like lappet of feathers arising from beneath the throat and from the sides of the neck. The cassowaries must also be included in our survey because of the curious upstanding helmet surmounting their heads, an embellishment that, although of a somewhat freakish nature, imparts a distinct air of dignity to the birds.

In regard to the reptiles, it would be easier to single out the more attractive species rather than those of a less pleasing aspect, for none can be described as

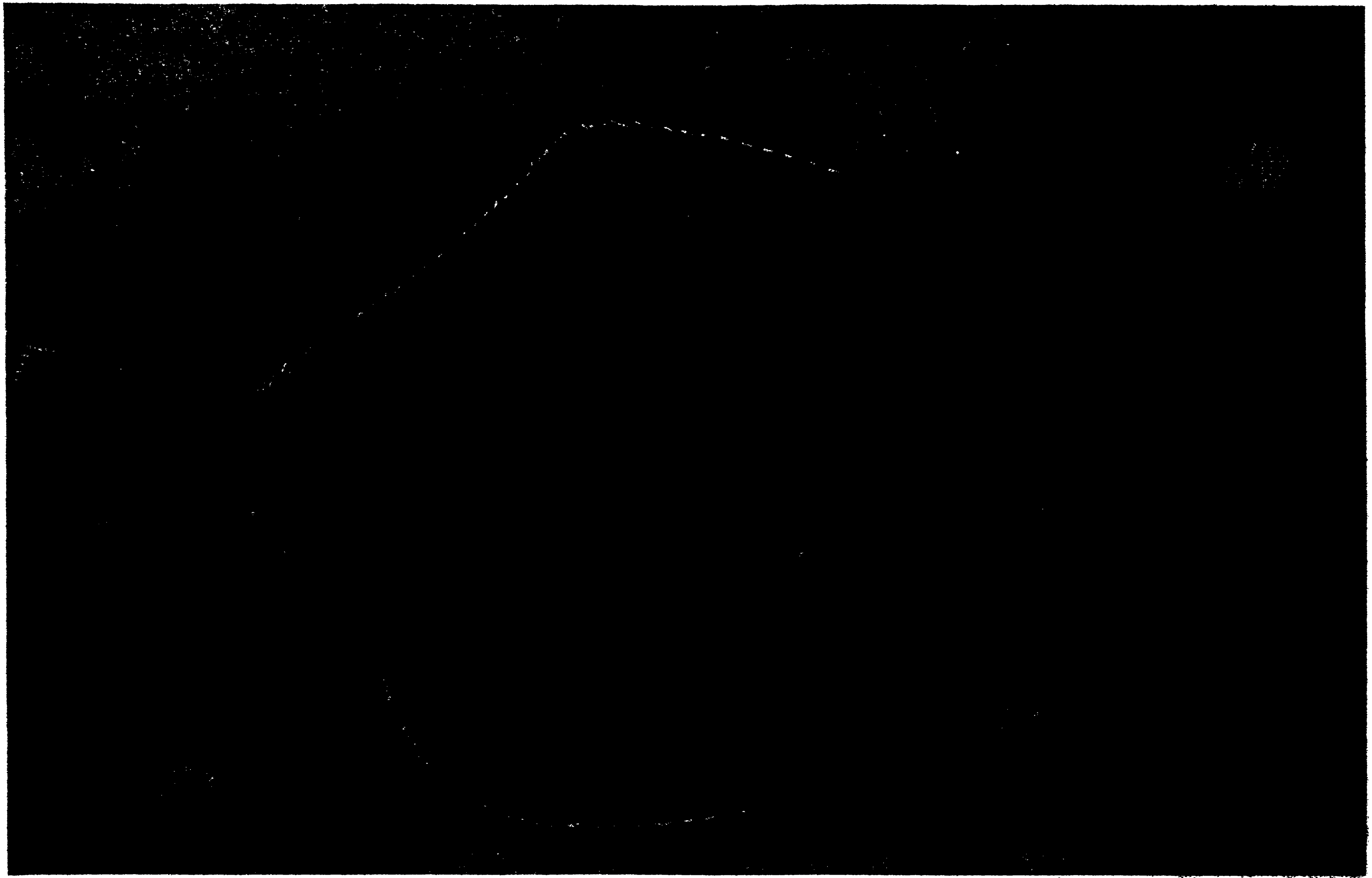
beautiful, except perhaps in their colouring. Among the snakes with unusual characters mention must be made of the shield-tails in which the caudal appendage terminates in a blunt-ended, flattened disk, instead of tapering to a point as in the case of all other serpents. As they live underground, burrowing through the soil like a worm, they are not often seen, but in the tea and coffee plantations of Ceylon and India, from whence the reptiles come, they are sometimes brought to light when the ground is being tilled.

There are so many curious types of lizards that it is only possible to mention a few in the space at our disposal, so we must content ourselves with selecting the frilled lizard and the moloch lizard as noteworthy examples. Both come from Australia, the former being remarkable for the large, scale-covered frill of skin that surrounds its throat and neck. Under normal circumstances this lies folded up and in repose over the shoulders, but when the creature is alarmed or irritated, it opens wide its mouth, expands the frill, bringing it forward so as to form a shield-like cuirass almost completely surrounding the head. In spite of its formidable appearance and defiant attitude, however, the reptile is quite harmless.



MONSTROUS CRABS FROM HOT CLIMATES

Japan produces the largest crab in the world. A horrid sight it is, for it spans a distance equal to twice an average man's height between the ends of its two great claws, and the other legs are in proportion. It is called the great spider crab. Above is a tropical crab, with one enormously developed claw



ADULT PLAICE WITH THE WONDERFUL TRANSFERENCE OF ITS LEFT EYE COMPLETED

At the age of two and a half or three years a plaice is adult and has reached a length of about a foot. Both eyes are then on the same side of its body although, in the early stages of its life, this fish had one eye on either side, as we shall see in the illustrations that follow. The plaice is a very important food fish, and is found in the North Sea and the Atlantic from Iceland to the Bay of Biscay. It does not reach the American coasts. The story of its strange metamorphosis from a normal to an abnormal fish form is also true of a great number of other flat fish of which there are about five hundred classified kinds. The best known beside the plaice are the dab, flounder, sole and halibut.

Chapter XCVIII

The Wonderful Story of a Fish's Moving Eye

By Henry Neil Milligan

Zoologist of the Horniman Museum

EVERYBODY must have noticed the wry countenances of the flat-fishes in a fishmonger's shop, but probably there are few people who know the story of those peculiar faces. The story has to do with a shifting eye, and some other curious matters.

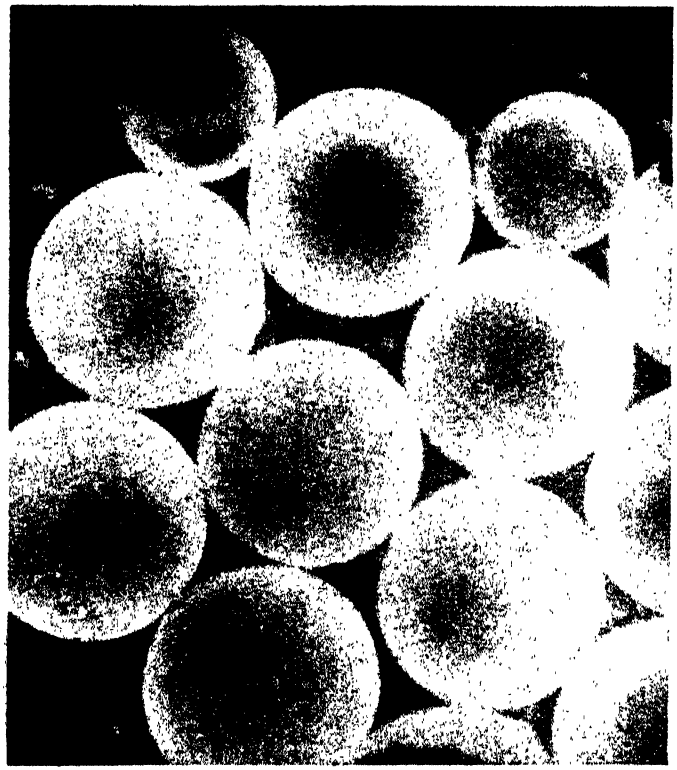
Let us consider for a moment the body of a fish which is not a flat-fish. Almost any one will serve, provided it is of ordinary shape, such as a cod-fish. It is smooth and rather spindle-shaped, that is to say, it is of a form which is fitted for easy motion through the water. It has a head, a back, a belly, right and left sides, and certain fins. Its eyes are in the usual place in the head, one on the right and one on the left, so that the fish can see on both sides.

We may now turn to examine one of the flat-fishes. There are about five hundred different kinds of such creatures known and named. The plaice, the dab, the flounder, the halibut, the turbot, and the sole are well-known sorts among the five hundred. However, they are all very much alike, and any one of them would doubtless be recognized at once as a flat-fish. The plaice may be taken to serve as our chief example in the following account, as it is a species which is very well known. The difference of its form from that of an ordinary fish is seen at a glance. Instead of being rather spindle-shaped, it is flat. Instead of having an eye on one side and an eye on the other, it has both its eyes close together on the upper surface. We may note, too, that the upper surface of the plaice is brownish in colour (with red spots), whilst the lower is white.

If anybody should be asked to say which is the back and which is the belly of a plaice, he might reasonably regard the question as quite unnecessary, or at all events as one which is very easy to answer. "Clearly," he might reply, "the brown surface must be the back, and the white surface must be the belly." If some proof be then demanded that the brown surface really is the back and that the white surface really is the belly, he could reply that the plaice, whether it is swimming or whether it is resting, always keeps its brown surface upwards and its white downwards. Moreover, he might add, the two eyes are there, on the brown surface, on the back, where they might naturally be expected to be in such a flattened fish. It is obvious, is it not, that the brown surface is the back?

But the student of nature must always be vigilantly on his guard against accepting the obvious without enquiry. It is obvious that the earth is flat—until it is shown to be round. It is obvious that the brown surface of the plaice is its back—until it is shown to be truly its right side. But, it might here be objected, if the brown surface is truly the right side of the fish, then the animal must have both its eyes on its right side, and this seems to be absurd. Nevertheless, the plaice really has both its eyes on its right side, and how and why they come to be in such an extraordinary position is the strange story to be told.

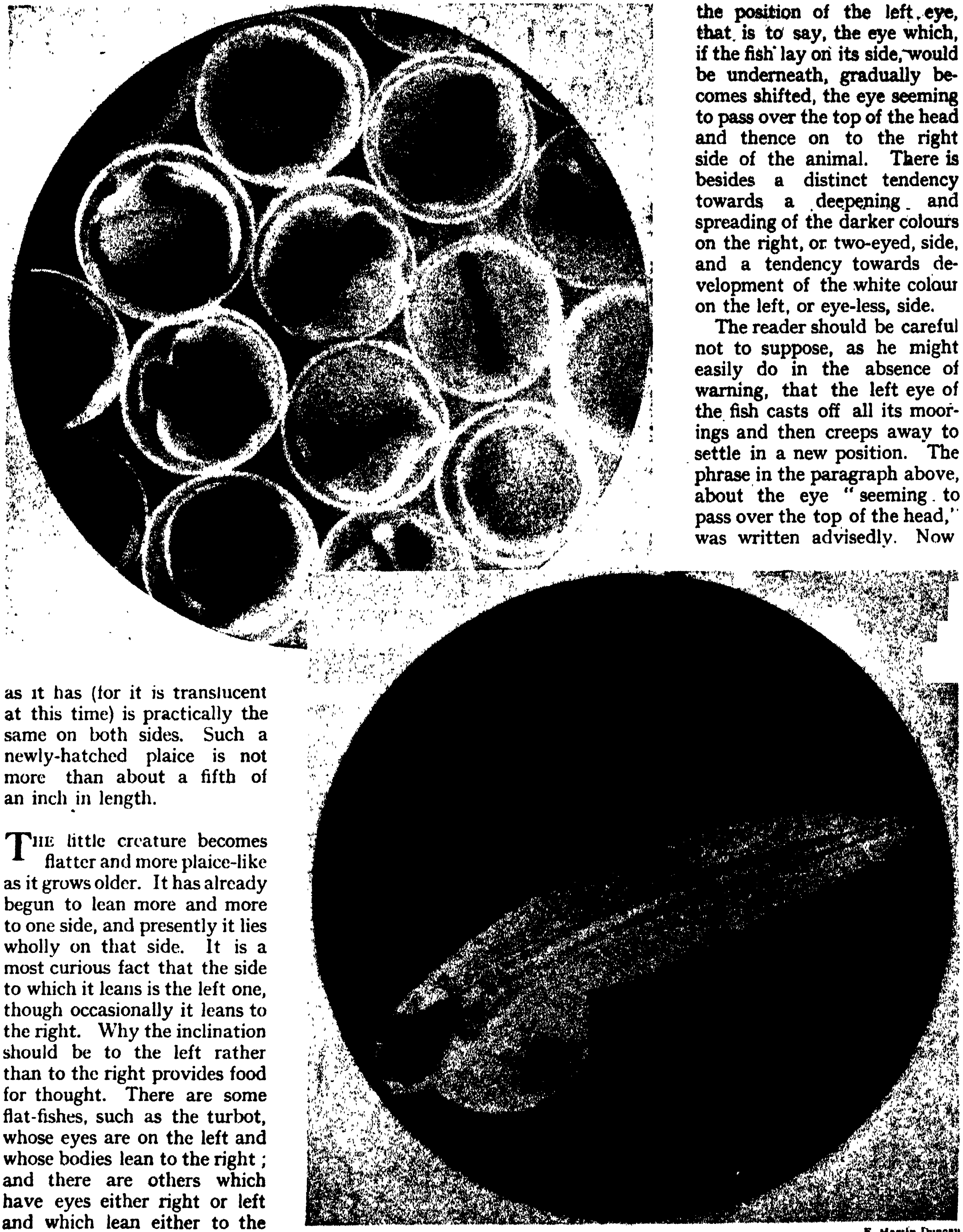
The tale begins with the hatching of the plaice from the egg. A baby plaice, just hatched, is not in the least like a flat-fish. It has essentially the form of an ordinary fish (with, in its earliest stages, a bulging bag of yolk, or reserve food-material, in the region of its stomach). Its eyes are not both on one side, but are on opposite sides of the head as in an ordinary fish. It is not brown on one side and white on the other, but such colour



F Martin Duncan

FIRST STAGE IN A PLAICE'S LIFE

About a quarter of a million eggs, of which we see a few here, are developed on an average by the ordinary female plaice, and these semi-transparent globules, with opaque matter at their centres, float near the surface till they eventually hatch. The young plaice make for shallow water.



F. Martin Duncan

EMBRYONIC FORMS AND THE BEGINNINGS OF GROWTH

The nucleus of the egg soon begins to take form until a recognizable creature (bottom) appears with a large bulge in its slight body where the yolk sac—a legacy from the egg—provides nourishment created originally by virtue of the parent fish. The upper photograph showing the embryo taking shape should be compared with that in the preceding page.

as it has (for it is translucent at this time) is practically the same on both sides. Such a newly-hatched plaice is not more than about a fifth of an inch in length.

The little creature becomes flatter and more plaice-like as it grows older. It has already begun to lean more and more to one side, and presently it lies wholly on that side. It is a most curious fact that the side to which it leans is the left one, though occasionally it leans to the right. Why the inclination should be to the left rather than to the right provides food for thought. There are some flat-fishes, such as the turbot, whose eyes are on the left and whose bodies lean to the right; and there are others which have eyes either right or left and which lean either to the right or the left. Here is more matter for thought.

As the habit of toppling to one side develops in the plaice the position of the left eye, that is to say, the eye which, if the fish lay on its side, would be underneath, gradually becomes shifted, the eye seeming to pass over the top of the head and thence on to the right side of the animal. There is besides a distinct tendency towards a deepening and spreading of the darker colours on the right, or two-eyed, side, and a tendency towards development of the white colour on the left, or eye-less, side.

The reader should be careful not to suppose, as he might easily do in the absence of warning, that the left eye of the fish casts off all its moorings and then creeps away to settle in a new position. The phrase in the paragraph above, about the eye "seeming to pass over the top of the head," was written advisedly. Now as the left eye does actually come to lie on the right side, we may seem here to be unnecessarily cautious, and a few words of explanation must be added. What really happens is that there is an alteration and a shifting of all the structures, including the bones, of that portion of the head which lies around and about the left eye, and the result of the changes is that all these parts become twisted over towards the right side, the eye being thus brought into a new position. It is more appropriate to say that the eye shares in a general shifting rather than that it passes to a new place.

It will be seen from the explanation given above that there is considerable twisting of the head and, as will be supposed, signs of this twisting can plainly be seen in the skull of the plaice. It may here be opportune to suggest that, if a skull of a plaice or other flat-fish be within reach, it will repay examination. It is distorted, and distorted in such a way that at first glance it is difficult to understand its arrangement; but the distortion chiefly affects the facial parts, and one look at its hind end, at the place where, in life, it joined the backbone, will show that it is essentially very much like the skull of any ordinary fish.

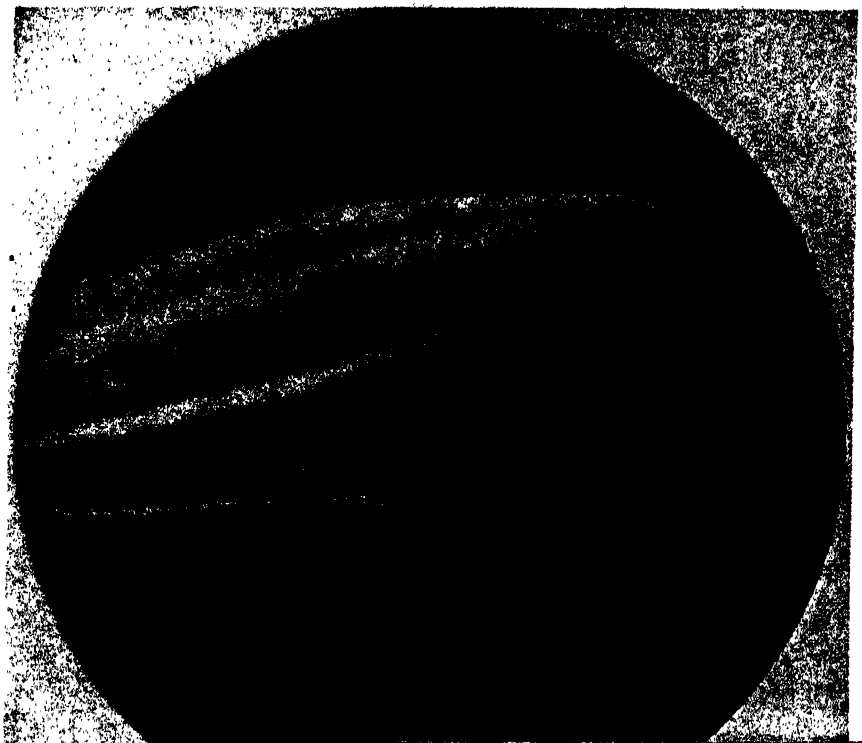
Flat-fishes are sometimes found in which the eye has failed to change its position and which have grown up with the eyes to right and left as in ordinary fishes. In some specimens the migratory eye has succeeded in getting only part of the way round the head.

By the time a plaice has grown to about half an inch in length it is, except in size,

F Martin Duncan

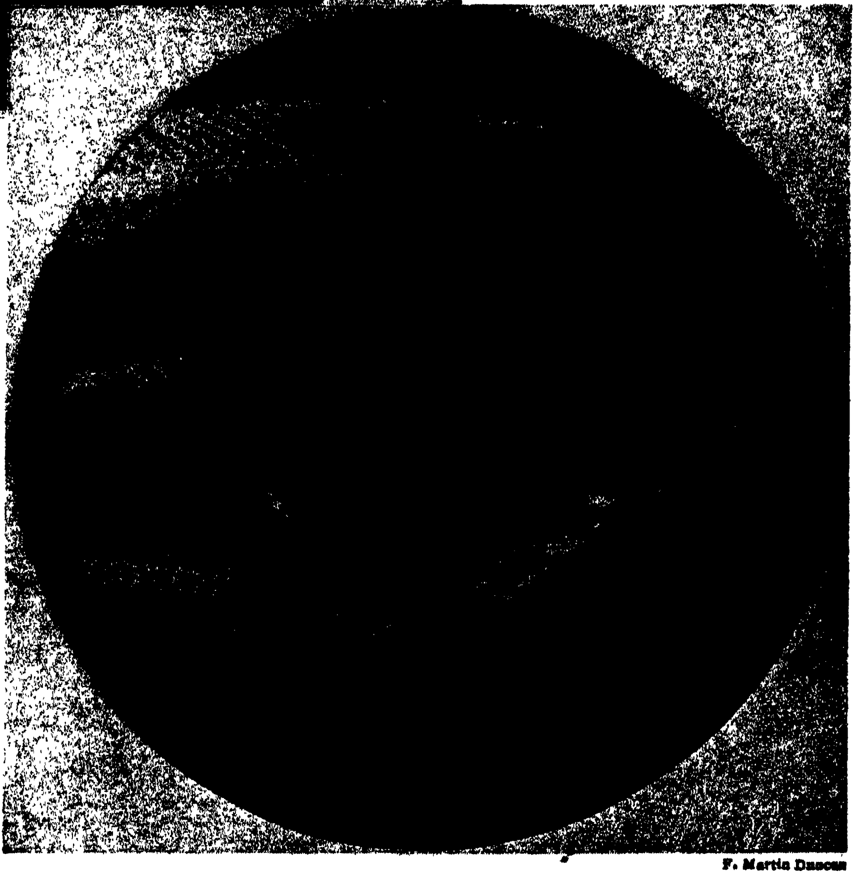
ABSORPTION OF YOLK: BODY BEGINS TO FLATTEN

Here we have the developing plaice growing rapidly into an ordinary fish form with two normal eyes. The upper photograph shows the yolk sac partially absorbed and the mouth beginning to form in preparation for the moment when (bottom) the sac is absorbed and the plaice must feed itself. Notice that the body is starting to flatten in the lower illustration.



essentially like the adult, having one side brown, one side white, and both its eyes on the brown side. It swims and rests always with its brown side uppermost. It is clear from all that we have learned of the plaice that it is to be regarded as a fish fitted for lying flat on one side, and that the carrying of the eye over towards the opposite, or exposed side, is a device for bringing into employment an eye which would otherwise have been underneath and useless. There is no doubt at all that flat-fishes have evolved from fishes with more ordinary forms and eyes.

But there is more in the story than this. The eyes of a plaice are flat when the fish lies dead at the fishmonger's, but in life those eyes can be raised at the will of the animal somewhat above the level of the surface of the head. Now, we shall find on enquiry that the plaice and most flat-fishes inhabit seas whose beds are chiefly of sand or mud. The flat plaice, with its brownish upper side, is plainly adapted for life on such a sea-bed. Not only can it lie flat against the bed, but its brownish colour, harmonising with that of the bed, helps to conceal it from the eyes of possible enemies. Further, a plaice will not only lie on the sea-bed, but also partly in it. When the fish sinks down to rest on the sand, it may make peculiar flappings with its body. By this means a little cloud is raised, and as the grains almost at once fall back on the outlying parts of the fish, the animal's outline is lost in the sandy bed. Only people who have watched flat-fishes concealing themselves can understand how effective the concealment may be. The writer of this chapter well remembers putting a sole into



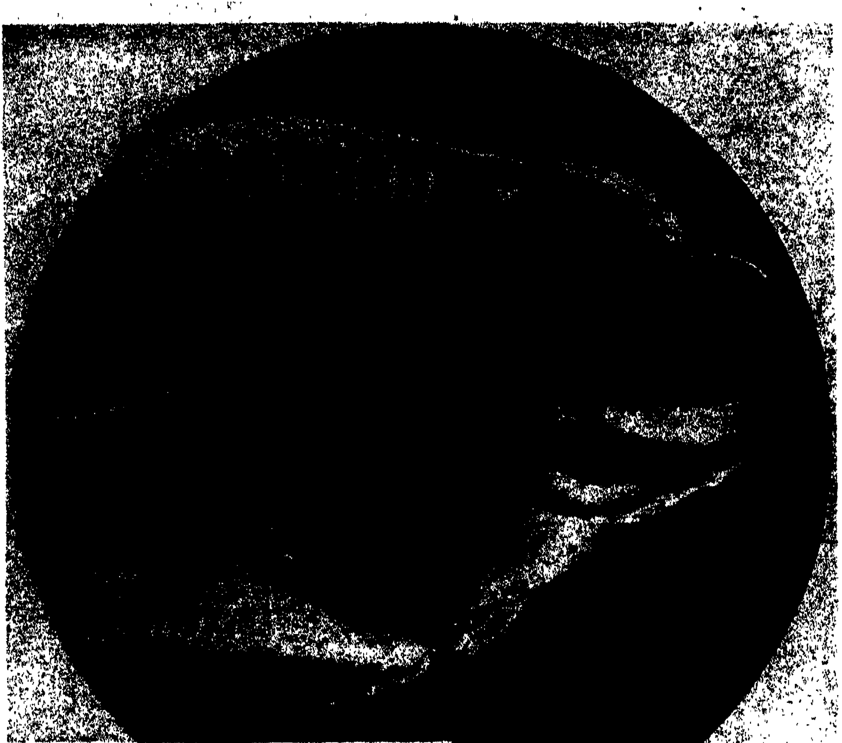
F. Martin Duncan

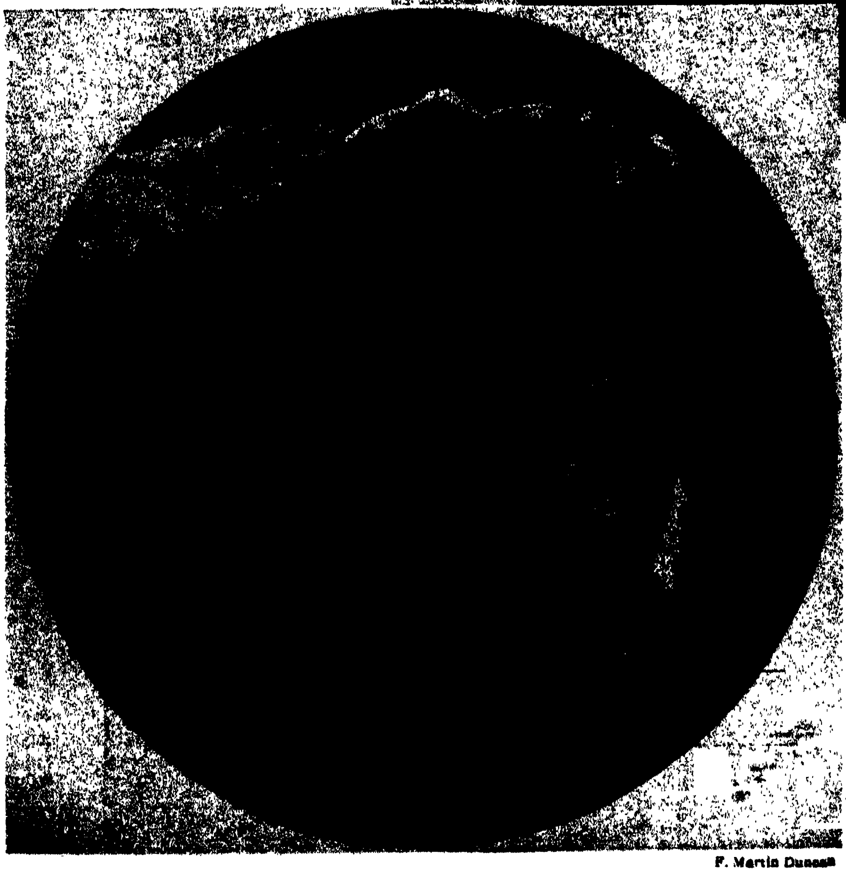
BEGINNING OF THE EYE'S TRANSMIGRATION

As the young plaice begins to feed for itself and to grow it gradually loses its transparency and its body starts to lean—usually towards the left—and to become dark on the right side. As it leans and the left eye tends to point always to the bottom of the sea, this eye and the whole surrounding part of the head become twisted. We see the start of the movement here.

an aquarium, whose bed was of mixed sand and fine shingle, and the fish, which rarely moved in the daytime, remained undetected in the bed for about three weeks. Those who were in charge of the aquarium had in the meantime supposed that the sole had died and been removed by somebody else. But to return to the eyes of the plaice. When the fish lies on the sea-bed, and particularly when it lies partly in the bed, it is clearly an advantage that the creature should be able to raise its eyes at will above the level of the surface of the sand, and this, as we have seen, it can do. It is then able to see enemies and prey.

The mouth of the plaice is awry, like its eyes and face generally, its jaws having a marked twist towards the left, or eyeless and lower side of its body. The reason for this is that the plaice takes its food, which is mostly living shell-fish, from the bed of the sea, and a mouth so turned is well fitted for picking up prey.





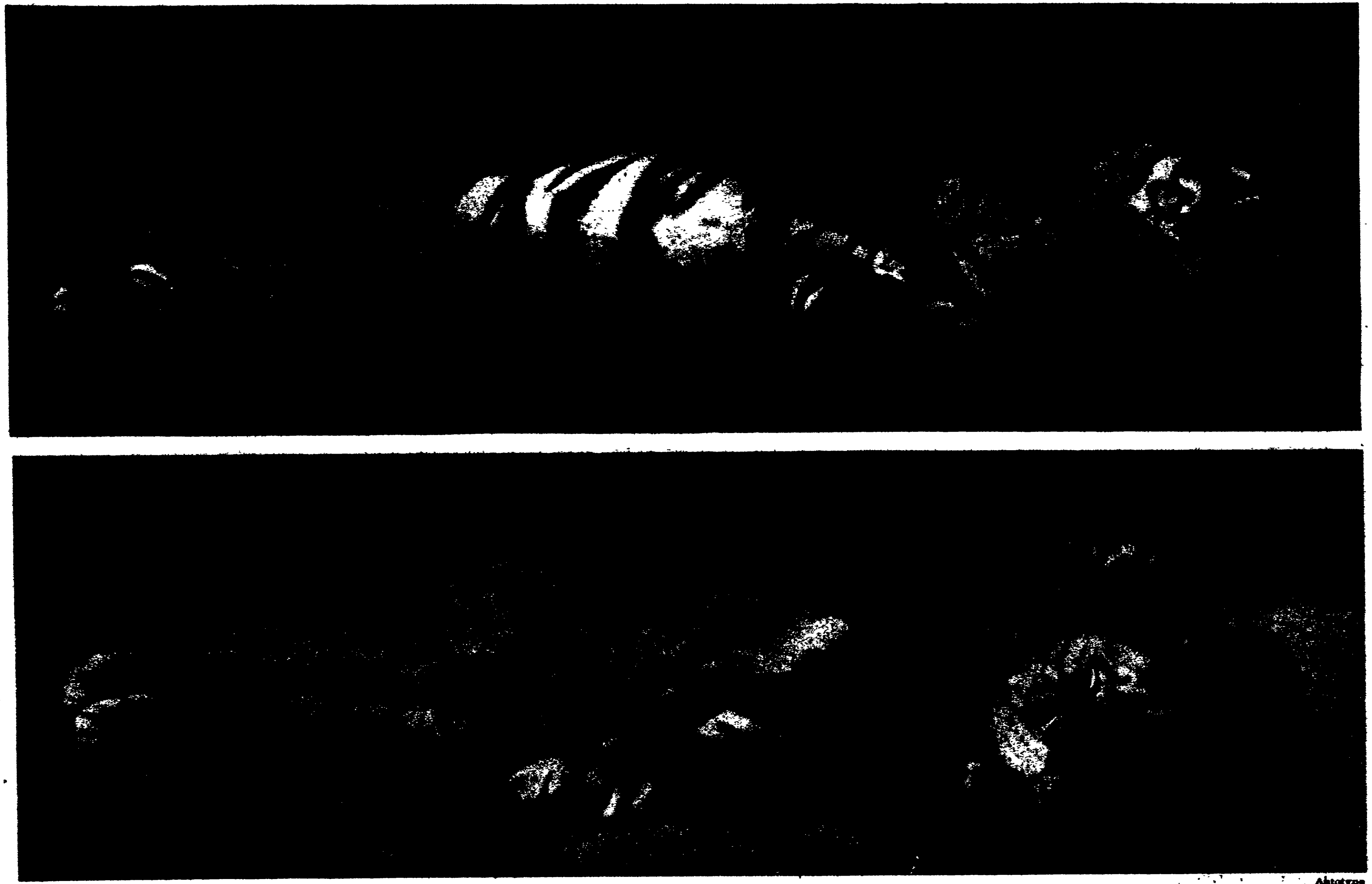
F. Martin Duncan

LAST STAGE THAT ENDS THIS EYE'S STRANGE HISTORY

Finally, when the plaice is adult, the facial twist is complete and the mouth has assumed the familiar contortion. The upper photograph shows the eye in the midst of its migration and the pigmentation—brown with red spots—developing on the right side. Below we see the plaice's head as it remains for life. As the fish grows it moves gradually into deeper water.

The reader will now be in a position to understand the why and wherefore of the peculiarities of the plaice: the reasons for its flat form, its brownish upper side, its shifted eye, and its twisted mouth. The fish is adapted for life on sandy sea-beds. It needs to be flat, so that it may lie close upon the sand; its upper side needs to be more or less sand-coloured, for the sake of concealment; its left eye needs to be carried to the upper side, where it can be used; and its mouth needs to be twisted, so that food may readily be taken from the sea-bottom.

And all this strange story has come to be told because we wanted to understand some wry faces on a fishmonger's slab!



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ATTITUDES OF LORDLY EASE: THE LION AND TIGER SPENDING THEIR HOUR OF REST

When the big cats decide to take their ease they do it thoroughly. Every line in their bodies, as we see them here, betokens utter relaxation. These great animals, so powerful and ferocious, spend very much of their lives in cultivating the gentle art of being really comfortable, and they are so constructed that the hard ground, whether it be a rocky ledge in the wild or only the floor of their cage, makes for them as comfortable a resting-place as any feather bed and down pillow to a tired human being. There is something imposing in this complete contentment and the spectacle of strength in repose when one considers the size of these great creatures.

Chapter XCIX

Rest Hour in the Animal World

By Frank Finn

Author of "The World's Birds"

It will be noted, even if one confines oneself at first to familiar domesticated and captive animals, that these present very great and often unexpected differences in their notions about rest.

To take indoor animals first, it is not unnatural to find the slim little canary, which, as a bird, is a member of the warmest-blooded class of animals, pretty constantly on the move during the day, and only settling down to rest at night; but it is rather surprising to find that the cold-blooded gold-fish seems never to rest at all, and displays quite twice as much activity as its feathered rival.

The highly-organized cat, whose splendid suppleness makes other creatures look jerky or stiff, sleeps a great deal, and even when not asleep sits still for long periods at a time. That it commonly devotes the night to the thrilling pursuits of love and war with their accompanying wild music may partially account for this, but not entirely; for the cats, as becomes the aristocrats of the animal world, are pre-eminently a leisured class. The tiger, if lucky enough to kill a large beast, will eat his fill, go to water to drink and then retire to bed; next day he will do the same, probably finishing off his cold meat; the day after he will also spend in repose, though not refusing any easy chance of another kill, and not till the fourth will he begin seriously to hunt once more.

The dog, like the cat, sleeps a great deal—probably more than he ought, for he is by nature a more strenuous animal than the cat, having a more energetic method of hunting, often in company, and seldom enjoying a great surplus of provisions. Under our care, he does not usually get enough exercise, as is shown by his excitement on hearing the word "walk," which to his simple mind means a very discursive run in which he works off a lot of pent-up energy. The humanitarian legislation which forbids the use of dogs for draught is probably mistaken kindness, and we should most likely hear less about the unpleasantly wolfish eccentricities of Alsatians if these animals were given harness-work to do.

John Roberts

WATER BOATMAN AT ANCHOR

Anchored to a water plant by its usually very active legs the little water boatman takes its pleasure in a quiet rest, inconspicuous, at any distance, among the protecting fronds. It provides a good contrast to the huge animals in the opposite page.

Going outdoors, we find the pig putting in more hours of sleep and rest than are natural, owing to his restriction to a sty or yard, and copious rations of rich food; allowed to roam in a pasture he is no more sluggish than most other animals.

Cattle and sheep rest a great deal, but one does not often see them actually asleep by day; and they are fortunate in being able to combine rest and feeding by chewing the cud, which, as everyone knows, is simply eating their hastily-swallowed food over again. This necessity for cud-chewing is one of the drawbacks of the ox as compared with the horse as a working animal; he must have time to chew the cud as well as to feed.

Horses, it will be noticed, though they rest a good deal in the standing position, lie down far more rarely than the ruminants; in fact, some horses have so confirmed a habit of sleeping in a standing position that their legs suffer thereby, and they have to be slung when in the stable.

It is noticeable that none of these hoofed animals lie down squarely, so to speak, but always recline to some extent. The elephant is never seen to lie down by day; at night he will lie down for three hours, get up and eat some fodder, lie down on the other side for another three hours, and then get up and finish his food.

A few mammals have the very exceptional habit of sleeping on their backs, at any rate at times; this has been recorded of the large Indian flying-squirrel in hot weather, and the writer has seen the hairy armadillo, the only species of these queer armour-plated beasts at all common in captivity, reposing in the same position.

A peculiar characteristic of seals in repose, noted by Mr. J. G. Millais in his fine

F. W. Bond

F. W. Bond

WHEN THE KING OF THE BEASTS TAKES HIS EASE: FOUR STUDIES OF LEONINE LEISURE

All lions spend much time in resting, but in captivity this proclivity is especially marked, the animals lying for hours with only an occasional lazy movement. It is probably boredom as much as anything that causes these prodigious stretchings and vast, protracted yawns, though the lack of natural exercise may help to induce a constant feeling of lassitude. Hunger wakes the lion very successfully even though it knows that the next meal is a certainty which will occur at the usual fixed hour. It is the resulting restlessness causing the worried pacing up and down so familiar to the crowds at the Zoo, which excite most interest, many people passing the sleepy lion with only a glance But this somnolence is worth a little study as these photographs show

F. W. Bond

F. W. Bond

TIGER AND PUMA: BIG CARNIVORA AND HOW THEY LOOK DURING THEIR AFTERNOON SIESTA

Although they are among the most active of animals the cat family—from tabby to tiger—spend a great deal of time in sleeping, curled up with heads comfortably tucked in or lying lazily stretched out. In its wild state the tiger, having made a large kill, will gorge itself, find water and drink and then retire to some place where it may be fairly sure of being undisturbed. In this page the bottom right and the two top photographs show some expressions and poses of the resting tiger while the bottom left-hand photograph is of a yawning puma. This very interesting beast has been dealt with in a previous chapter (see p. 241).

work on the British Mammals, is their extreme dislike of getting wet when they have hauled out for a doze on a tidal rock. As their coat dries they get sleepy, but when the rising tide begins to wet them again they show by their attitudes considerable distaste for what one would consider their more congenial element.

The sea-otter, which is far more aquatic than the more familiar fresh-water otters, will sleep on its back at sea. Ordinary monkeys sleep perched on the boughs, sitting upon their haunches; in the case of a pair of Japanese monkeys that became the parents of a young one at the London Zoo before the War it was noticed that the old ones slept face to face, with the baby nestled in between, so that it had the benefit of their thick coats.

THE great man-like apes sleep reclining, on beds which they make for themselves in the trees, something like wood pigeons' nests on a gigantic scale; in such a bed a great orang-utan which escaped from the Zoo bivouacked for one night of freedom, making his couch in a surprisingly short time.

The male gorilla, however, in some localities at any rate, makes his bed on the ground. The orang appears to use bedclothes of some sort—presumably large leaves, as it seems to have a strong instinct in captivity for putting things on its head, though this may be merely "aping" human headgear.

Some of the hoofed animals make beds in a more or less crude way; wild pigs construct shelters by biting off grass or cane and then pushing themselves in under the heap that they have made. The chiru antelope of the bleak uplands of Tibet scrapes out a lair for itself in which it lies covered except for its tall upright horns, the purpose apparently being to get a wind-break rather than to conceal itself. Lichtenstein's hartebeest in South Africa, too, also makes a "bed," out of which, according to Mr. Millais, it is often unscrupulously turned by the better-armed sable antelope.

In the Himalayas the musk-deer, which is more like a hare than a deer in its habits, follows the hare-like custom of establishing for itself a "form" or squatting-place, which may also be called a bed, as it is resorted to for rest. The lower animals love routine, and resort to the same places for rest, whether by day or by night, whenever possible.

The writer noticed this particularly in the case of a common kingfisher which haunted the pond in the Indian Museum grounds, Calcutta. At one end of this a tree grew out of a mass of masonry, and on a twig of this the bird always perched when not fishing, so close to the wall that his forcibly ejected droppings made a white patch on it against which he stood out like the bull's-eye of a target.

STERNDALE has also recorded a case in his "Mammalia of India," in which a wary black buck which he hunted about for three days before he could shoot it, never left its ground, and even slept every night in a field near his tent.

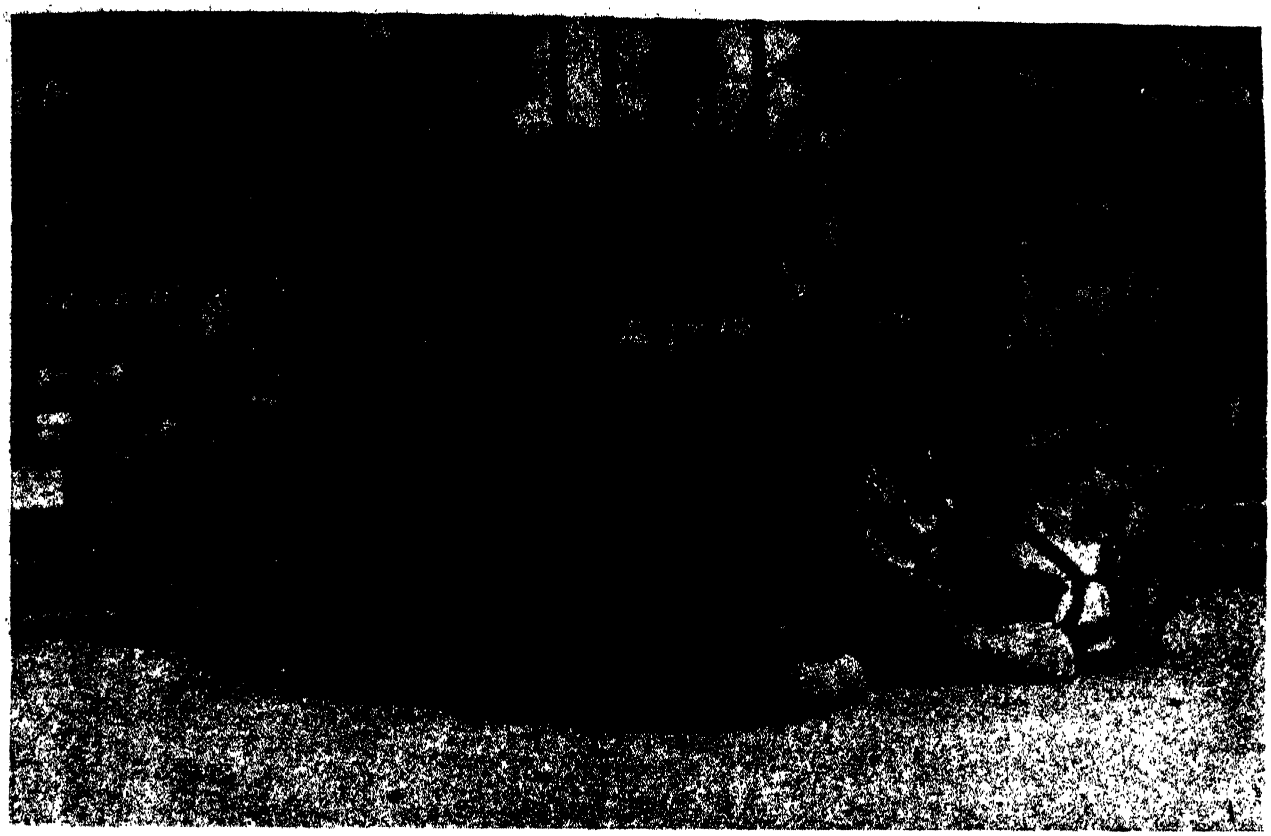
The otter is peculiar in often changing its lair, but even here there are certain "holts" well known to otters generally, which use them as places of call when travelling. Gadow, in his volume on reptiles in the Cambridge Natural History series, gives instances of the love of routine repose displayed by reptiles, notably in the cases of eyed lizards, tree-frogs which haunted particular spots, and of a tortoise which after hibernation went straight to a favourite basking spot which it had used the year before.

Tortoises display interesting intelligence or instinct in their poses when basking: though disliking really hot sun, they will make the most of feeble sunbeams by tilting their shells against a wall to get the utmost amount of heat, a habit which was noticed in the case of the common land tortoise by Gilbert White, and has been observed by the writer in that of the common European water-tortoise. Reptiles at rest display a remarkable power of sustaining the most rigid and apparently awkward-looking poses without such mechanical help, and often look as if they had fallen asleep while in the act of walking.

Land poultry rest a good deal by day, but do not sleep; like the ruminants with their cud-chewing, they can combine repose with another needful activity, in this case a toilet performance, the dust-bath. This begins, indeed, with much expenditure of energy in scratching and wing-scuffling, but, once well worked into a dust-hole, the bird reclines more or less and takes things easily. It is only when so occupied, or when basking, that the birds do recline; otherwise they stand if on the ground, or squat if perched, when resting.

AQUATIC poultry sleep a great deal by day, but then, like the dog and cat, they are quite active by night, and in fact, foxes permitting, ducks are best left out then, as this is their best time for hunting slugs, worms, and so forth. The land poultry go to roost at different times: the guinea-fowl earliest, perhaps because it is on the trot all day and seldom seen to rest; the peacock latest, for his leisurely strolling is not calculated to tire him much. Both peafowl and guinea-fowl are much lighter sleepers than ordinary poultry: at any rate, they are always ready to give the alarm if anyone approaches, and peafowl at any rate are not helpless at night like ordinary fowls, but, if then alarmed, will fly to another perch. A pea-hen which escaped from a dealer's premises which used to be on the terrace in Covent Garden, thus lived at large for several months, and was only captured at last by flying at night to a known window-sill where she was seized.

The Muscovy duck, now coming to the front again after being neglected for half a century, offers a very curious case in being a bird with the lethargic habits of a reptile. Although it swims as well as the ordinary duck, walks better, and flies strongly, it spends its time much as most reptiles do, being mostly quiescent, though not actually sleeping; yet it is capable of vigorous action when roused by anger or any other emotion. It often perches, being descended from a



F. W Bond

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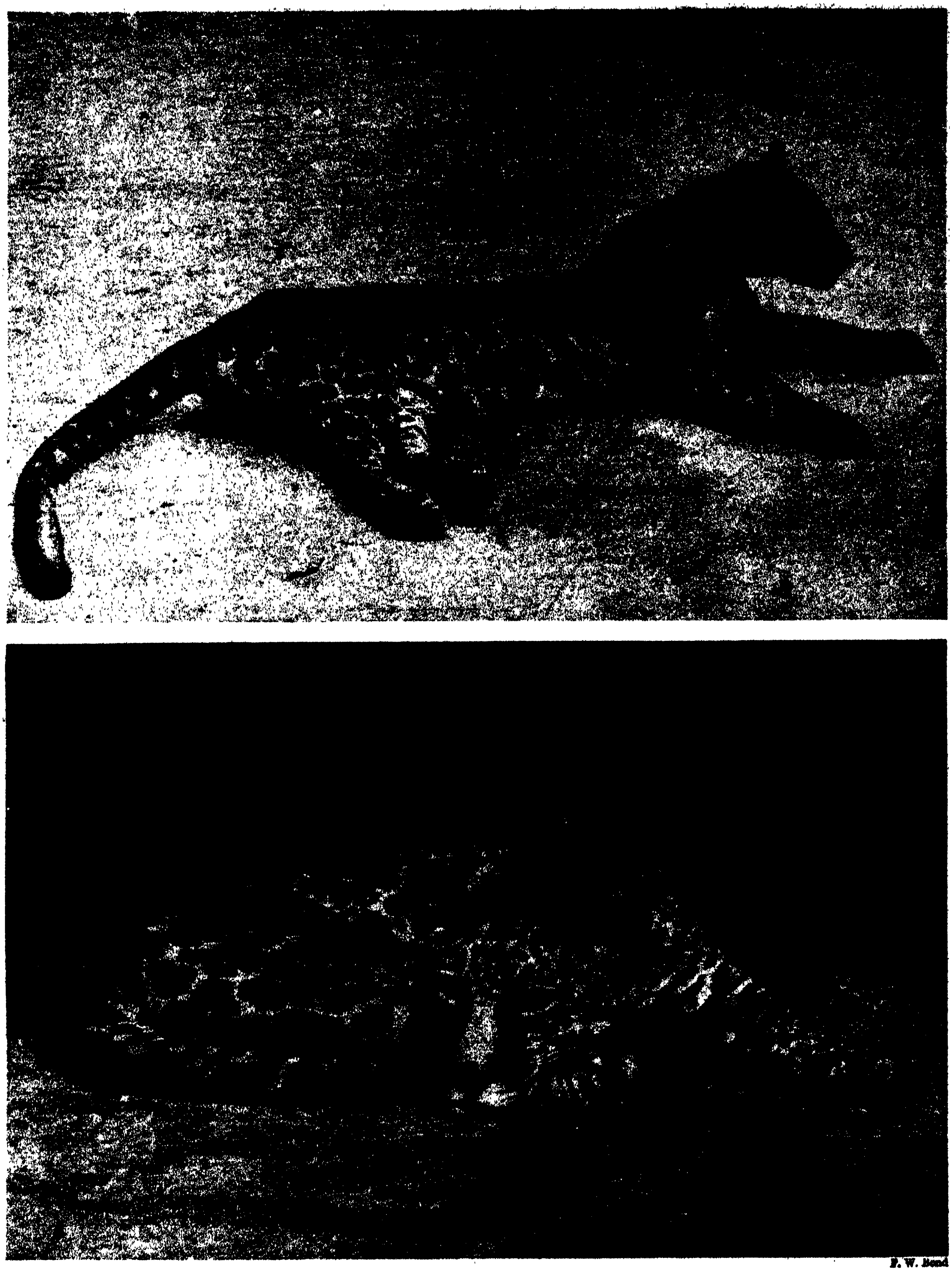
LION AND LIONESS SUNNING THEMSELVES AT THE LONDON ZOO

When the summer weather brings a genial temperature to the London Zoological Gardens and the animals are able to enjoy, out of doors, climatic conditions more approximating to their natural ones than usual, the lions soon avail themselves of the change. We see above two views of a handsome pair, lion and lioness, taking a sunbath in the outside portion of their cages. Lions enjoy sleeping in the sun as well as any human does, and will lie contentedly dozing for a long time—too long for some visitors, who had expected to see a little ferocity.



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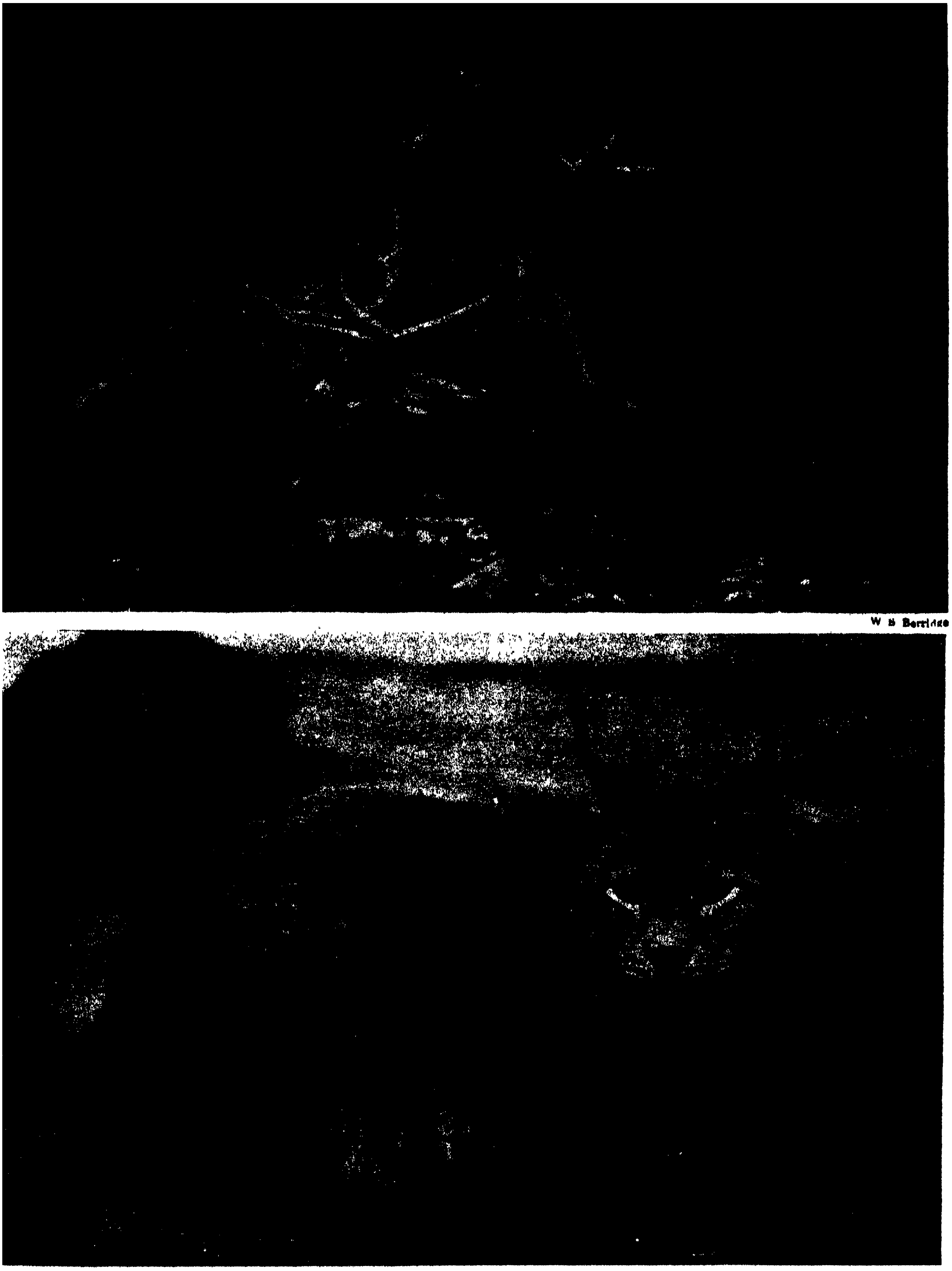
LITHE GRACE IN REPOSE: JAGUAR AND LEOPARD DOZING

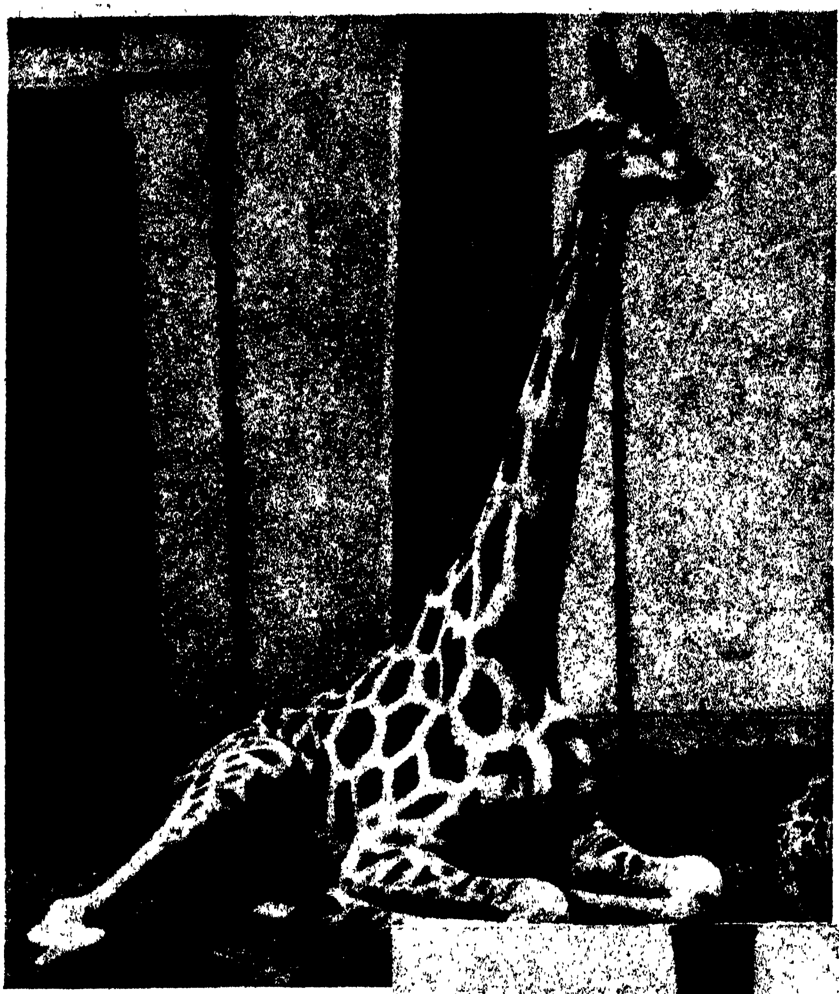
What the lions and tigers possess in size the jaguar (bottom) and the leopard (top) make up for in grace and lithe movement. A jaguar cannot be ungainly, and when, as we see it here, it curls its handsome head round upon one paw and dozes, one can only think of the most handsome cat that was ever created seen through a magnifying glass. The leopard in the upper illustration was photographed while having a rest in the middle of the road at Bengoli, in the Belgian Congo. It was the pet of some native children there.



W S Berridge

HIMALAYAN LYNX AND A WAPITI STAG IN RESTFUL ATTITUDES

This lynx (bottom) comes from the Himalayas, and lives at an altitude of ten thousand feet. The lynx is probably the fiercest of all the cat tribe, its rage being really demoniac to watch and its claws terrible in their operation. In repose it only just suggests the spitting, clawing devil into which it can, in a moment, turn. Above we see a wapiti stag curled round like a dog, but with one of its forelegs stuck out in front. This is a strange attitude to choose for resting.



J. T. Roberts

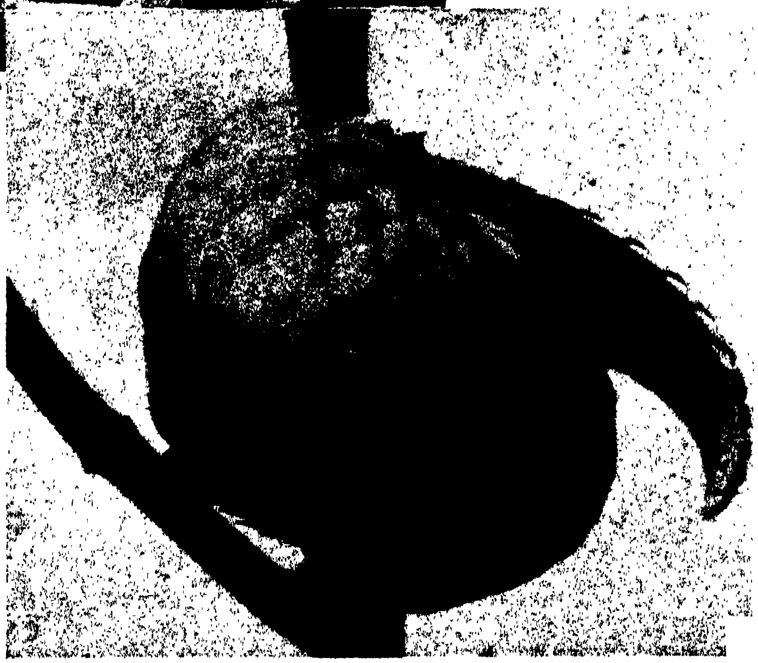
tropical American species which, like most tropical wild fowl, is a percher; and then, like such birds generally, stands up, though it sits down when resting on the ground, thus behaving in exactly the reverse way to the land poultry. Parrots differ from other cage-birds in remaining awake as long as the family is about.

The mechanism by which a sleeping bird unconsciously retains its grip on the perch is very interesting; by bending the leg of a dead bird up against the body the toes will be seen to contract, so that when it sinks down on its perch it automatically, by the arrangement of the muscles of the tendons, clamps itself on to its support. Many birds, however, sleep standing on one or both legs, but the shanks in such cases are often a little inclined from the perpendicular, which must give some pull on the toes; probably little actual grip is required unless the wind begins to blow, when the percher would no doubt wake up and consciously hold on.

Perching waterfowl, however, as has been said, generally stand in repose, but in any case these cannot depend much on grip; their hind toes being usually too small to be of the slightest use, and also placed too high up.

That curious South American bird, the Cariama, perches with a foot even less adapted for grasping than a duck's, the hind toe being so high that it could not possibly be of use, while the front toes are very short. This bird sits down on its perch, and when basking by day rolls over so far that it lies almost on its back, but not quite.

Its compatriot the rhea, the so-called "ostrich" of America, has a most curious and unique way of taking its ease at times.



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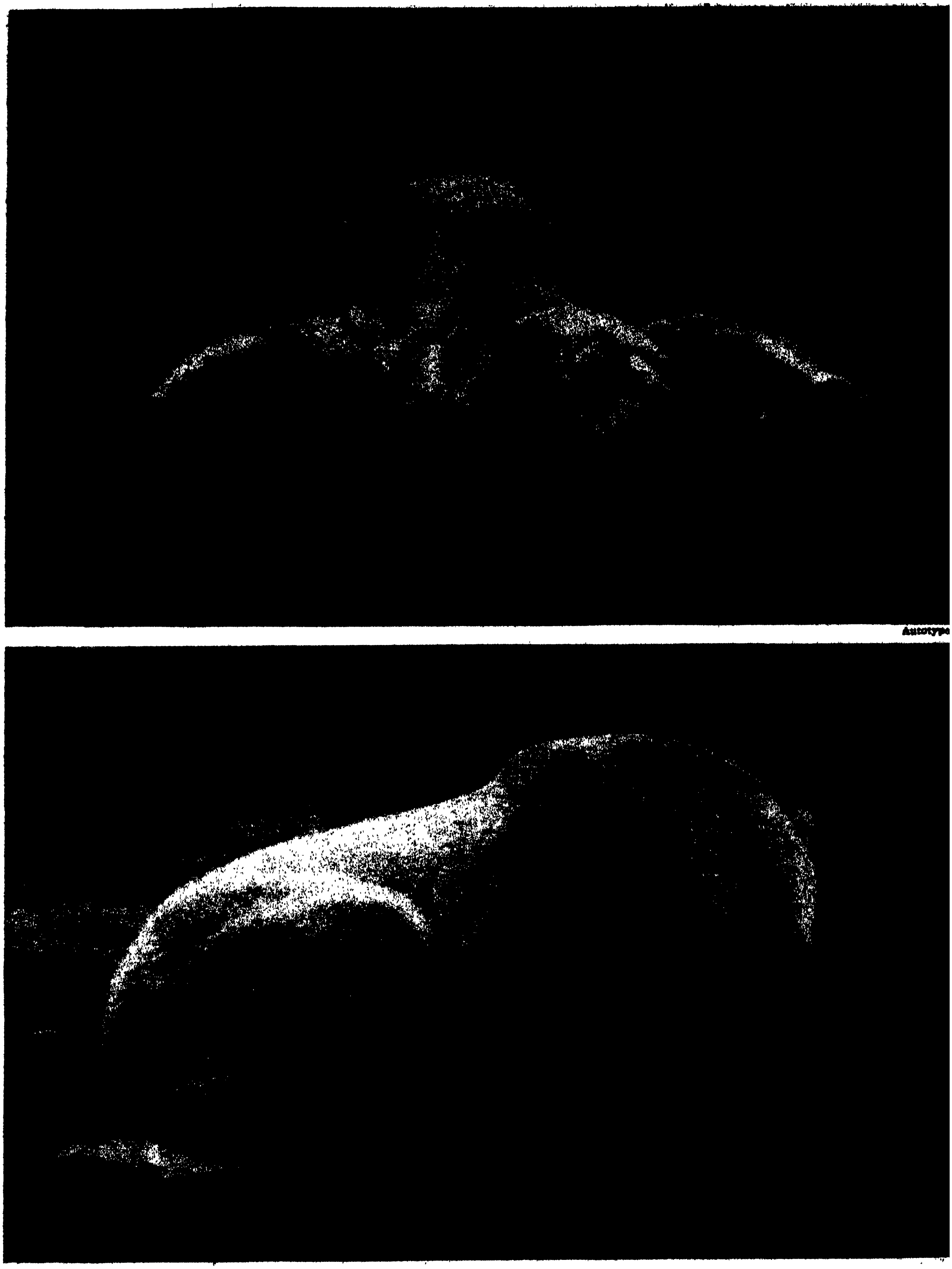
STRANGE POSTURES OF PANGOLIN AND GIRAFFE WHEN RESTING

When the pangolin (bottom) is tired of climbing about among the trees it just curls itself round a branch, presenting merely the appearance of a suit of scale armour when seen from behind. The giraffe is awkward to look at when it is resting. Even when taking its ease the neck is at full stretch in a restless, watchful way.

COMFORTABLE AND UNCOMFORTABLE-LOOKING WAYS OF LYING: BIG SEAL AND CAMEL

Many of the seals are so fat and awkward on land that sleep seems to be the only suitable occupation for them. This one here (bottom) looks comfortable almost to the point of helplessness, as though it had eaten so much that all movement was indefinitely postponed. The camel (top), on the other hand, looks more dead than alive as it abandons itself entirely to fatigue. Its head is turned round in the most extraordinary way so as to look right away from the rest of its body.



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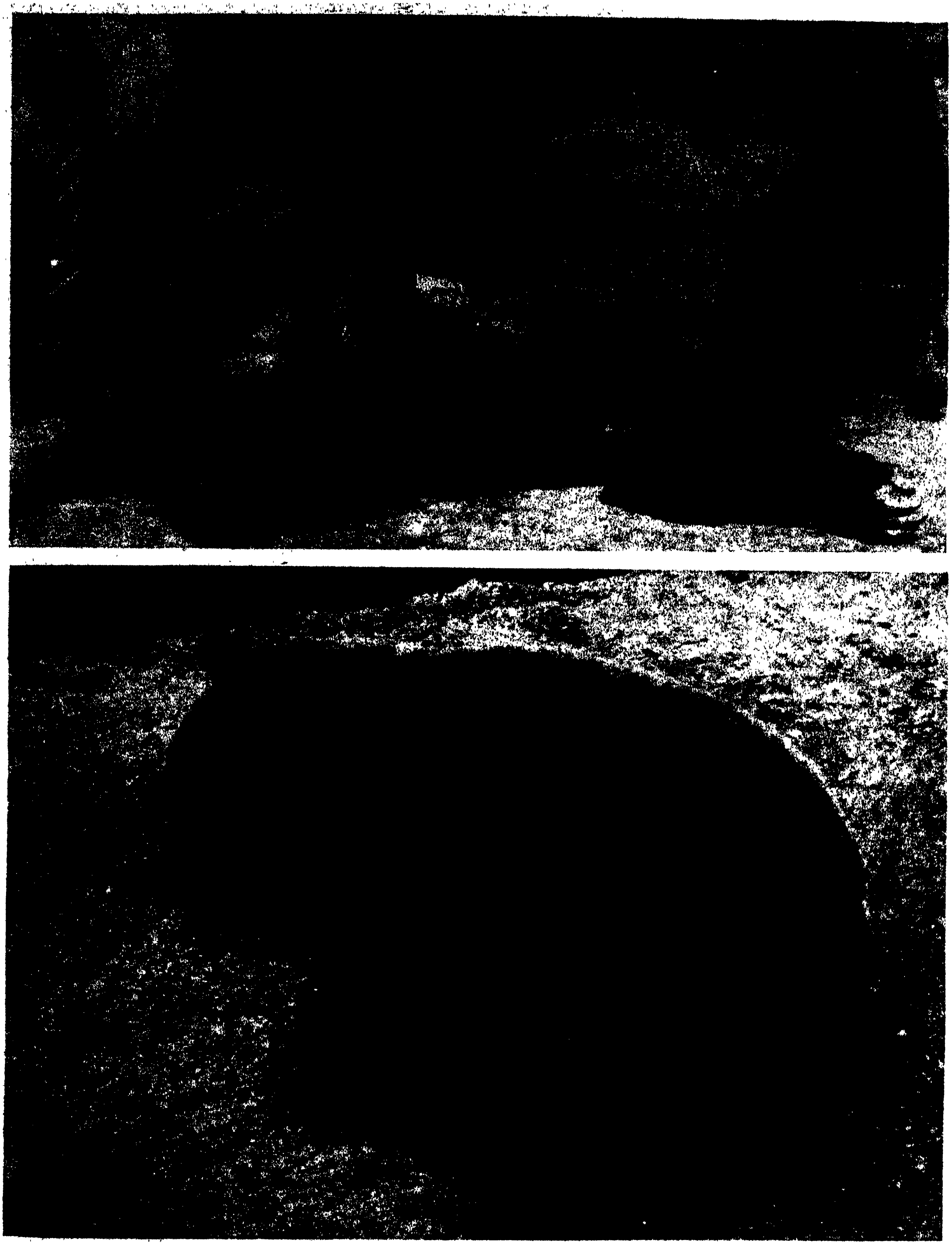
TWO POSTURES IN WHICH POLAR BEARS MAY BE FOUND ASLEEP

In the upper photograph the polar bear looks more as if it had been just shot than as though it were merely sleeping. The strange spread-out, swimming position is seldom seen in animals, and it contrasts strongly with the attitude of the other polar bear (bottom). This one makes a fine picture as it lies on the edge of the deep concrete trench that defends one of the Mappin Terraces at the London Zoo, dreaming, perhaps, of the unconfined spaces of the Arctic and a whole seal for supper.



BEAR AND GIBBON MAKING REPOSE COMFORTABLE EACH IN ITS OWN WAY

The bear (bottom) lies rather quaintly with all its four feet placed firmly together, and has a neat appearance as it takes forty winks. The gibbon, on the other hand (top), spreads itself over this business of resting, and has elaborately made a hammock of itself by grasping one rope with a foot and another with a hand. For this method of resting it can at least be said that, so far as concerns the gibbon, it looks comfortable. It is quite common for the monkeys at the London Zoo to use for rest the apparatus given them for exercise.

F. W. Bond

lying down with its long legs stretched out behind it, while the long neck is erect and the eyes closed. No other bird ever assumes this position, which would be a most dangerous one to recover from in case of surprise. At other times the rhea will sit with its legs tucked under it in a normal way, and its long neck resting on its back ; but it seems never to " tuck its head under its wing," nor do any of the specialised flightless running, or " ratite," birds do this except the kiwi. The kiwi is such a sound sleeper that it can be picked up before it will untuck its head—which, by the way, cannot be put under the tiny wing. But birds in this repose posture do not actually put their heads under their wings, but rest them on the shoulder, snuggling them in between the long shoulder-plumage and the basal joint of the wing lying parallel to the body and concealed by this cloak of plumage. In fact, the writer was only enabled to find the exact position by observing an unfortunate parrakeet in India which was a feather-eater—a very rare parrot-vice in that country—and had stripped himself all but his head, so that it was possible to see exactly what part of his anatomy he used as a pillow.

F. W. Bond

TAME APES IN SOME OF THEIR "OFF MOMENTS"

By the expression on its face one might conclude that this chimpanzee (bottom) curled up on the flat top of a sawn tree stump, was not finding this resting-place very comfortable. But hard surfaces do not worry any but domestic animals, as a rule. The gorilla in the upper photograph is enjoying the height of luxury with a blanket and a lady to caress its back

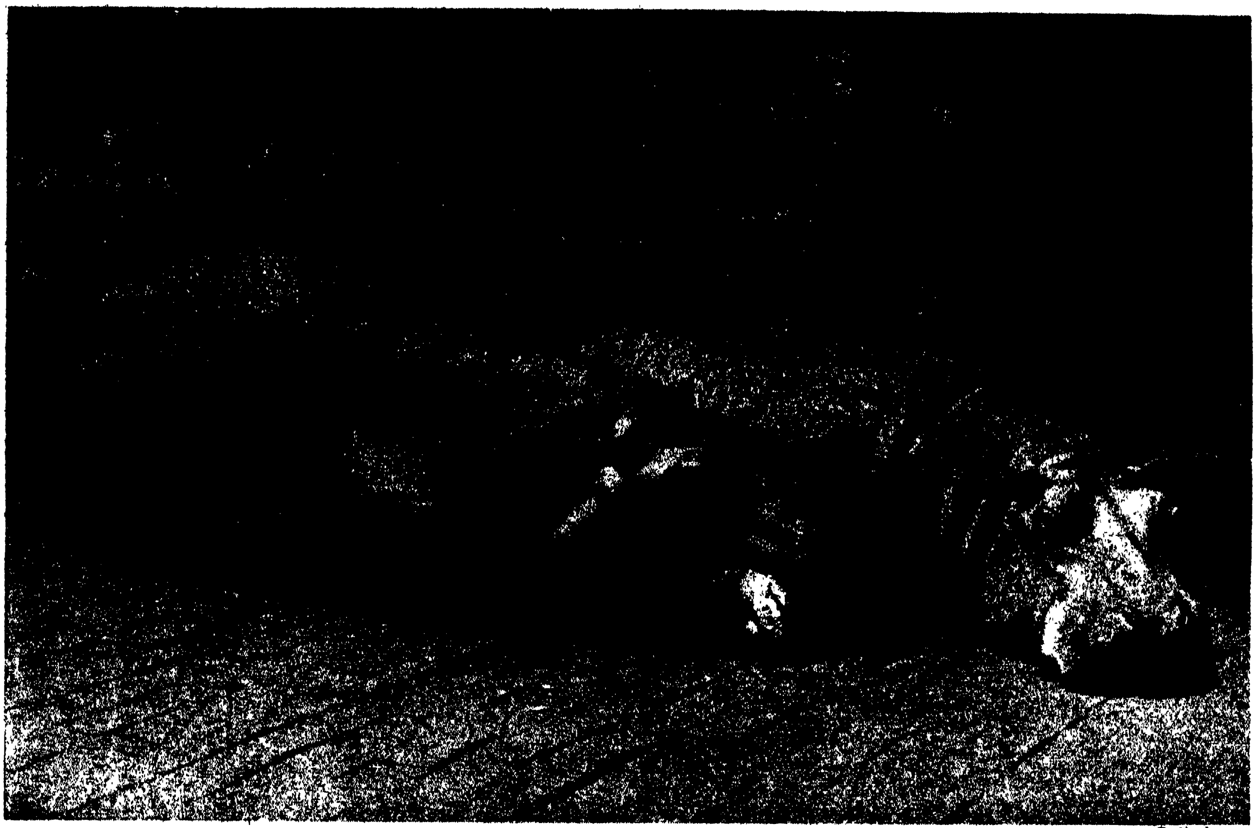
Many birds like to repose by day sitting down on their hocks, the species which do this being usually large and long-legged species like the carrion-feeding storks—adjutant and marabout.

Although, as above hinted, most reptiles are very lethargic, some are quite active especially the tortoises, in spite of their heavy shape ; the sea-turtles in particular, in an aquarium at any rate, are hardly ever still. The little wall-lizard, too, is pretty constantly in motion.

No reptile, however, will remain long active in a really low temperature, and this would make their general hibernation in winter easier to understand, were it not for the fact that many of the warm-blooded mammals also hibernate, and that tropical reptiles will " aestivate," that is to say, become torpid during the long dry season, when it is hot enough in all conscience. The same cause evidently brings about both aestivation and hibernation—terms which mean prolonged sleep under droughty and frosty conditions respectively. Certain animals overcome the difficulties of finding food attendant on extreme drought or frost by passing into a state of torpor until favourable conditions obtain once more. It may be remembered that extremes both of heat and cold produce sleepiness even in ourselves.

The daytime sleep of the British bats, at any rate, is particularly sound, and forms a sort of physiological link between ordinary sleep and hibernation, as they are practically torpid rather than asleep till the time comes for them to wake up, being very cold, and taking ten minutes or more to become active.

Flying-foxes do not hibernate, but then they do not live in climates with a cold winter, and are fruit-eaters ; and they probably sleep less by day than most other nocturnal mammals, for they quarrel so



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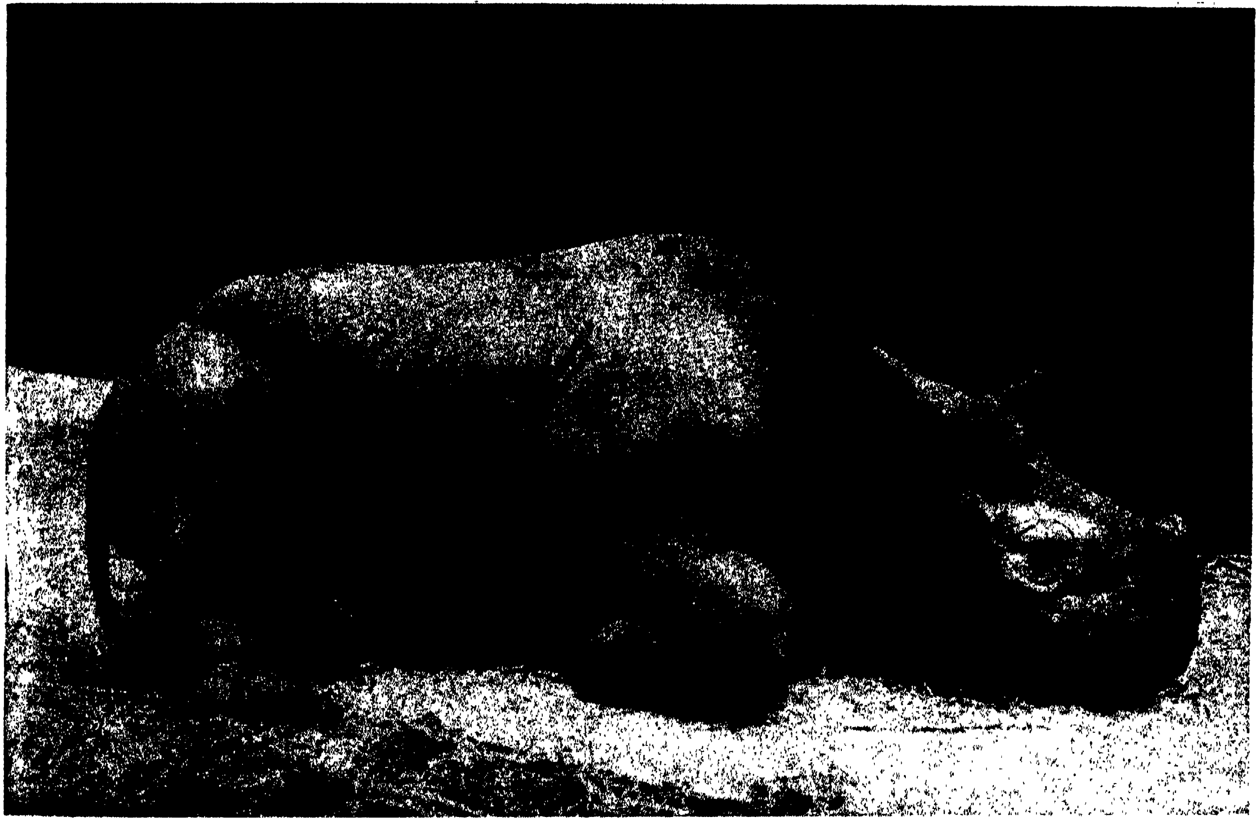
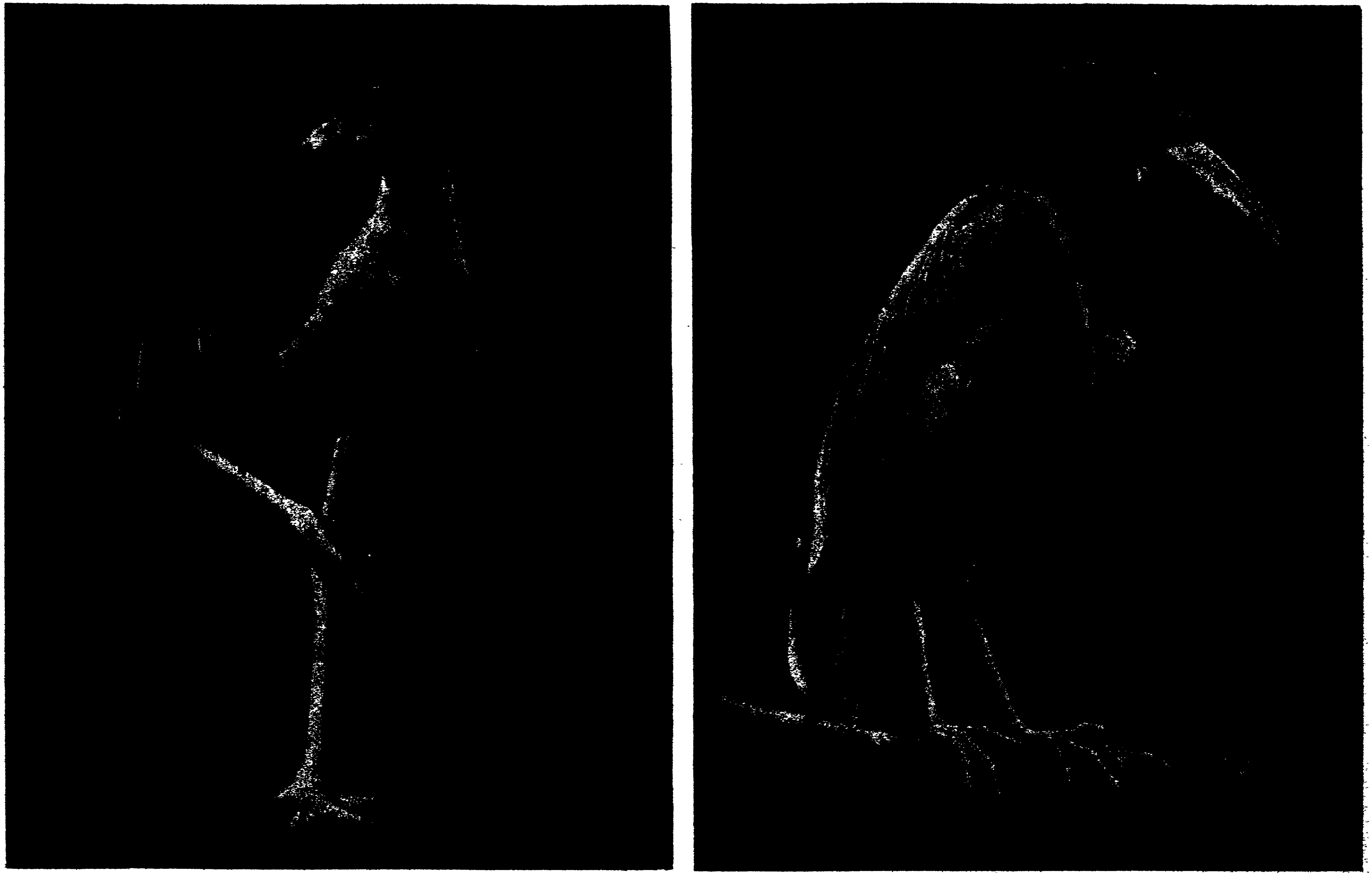


RHINOCEROS AND HIPPOPOTAMUS IN RESTFUL ATTITUDES AT THE ZOO

This young rhino (bottom) has adopted an apparently uneasy pose for lying in. The forelegs are doubled up under the body and brought over to the same side. But whatever this attitude seems to us, the young animal finds it suitable to its needs, and we can see by the way the nose is dropped contentedly to the ground that the animal is enjoying its rest. The upper photograph shows us two hippos sunning themselves side by side on the brick floor of their yard.



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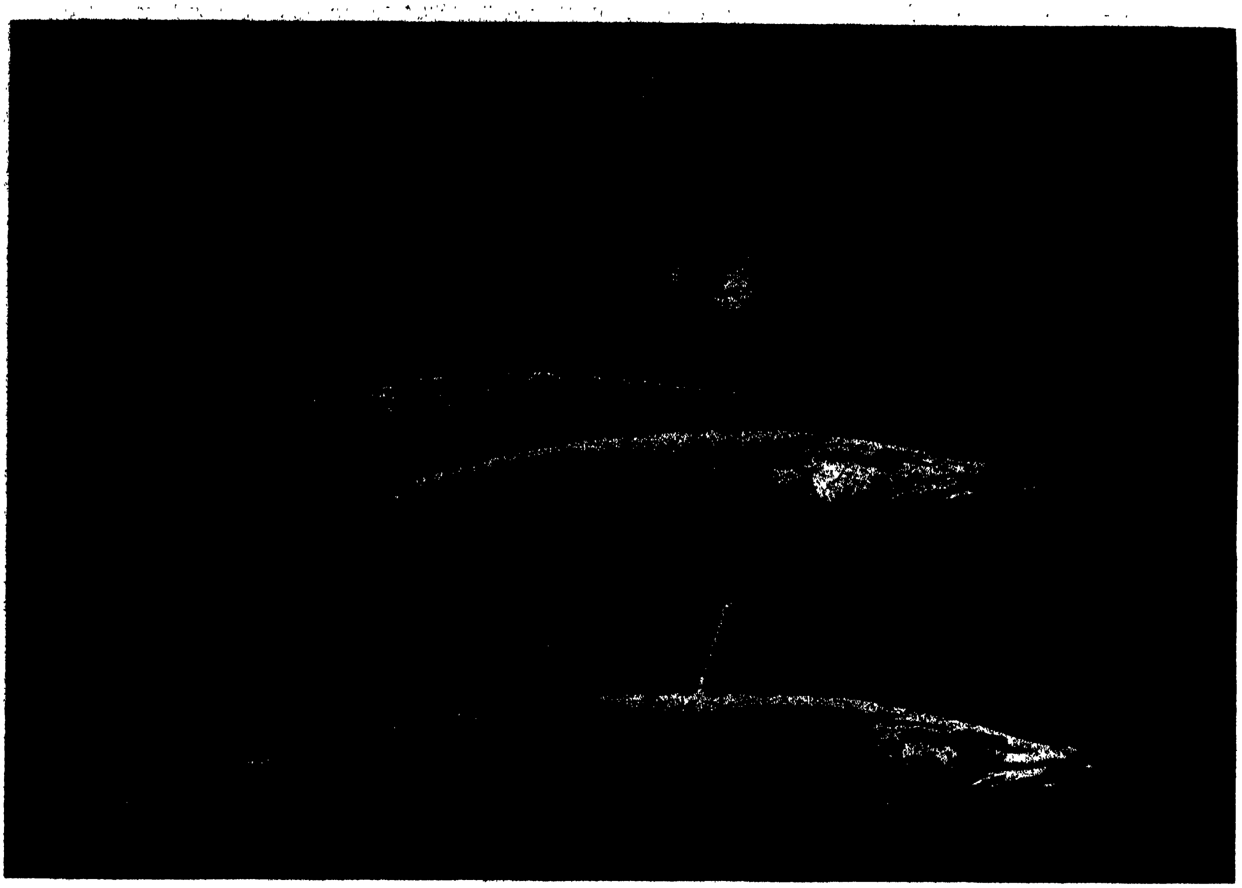
W. S. Berridge

ONE LEGGED AND TWO LEGGED METHODS OF RESTING: EXEMPLIFIED BY MARABOU STORK AND BOATBILL

When a perching bird sits on a branch the mechanism of its toes is so arranged that the sleepier the bird becomes and the more it sinks down upon its feet, the tighter becomes the grip of the claws round the branch. This may be easily illustrated by pressing the legs of a dead bird up against its body when the claw will be seen to contract. The large carrion-eating storks like the adjutant, or the marabou (left) often rest squatting on their hocks, though for sleep they seem to prefer standing on one leg. The shanks of the legs are usually inclined a little from the perpendicular, which probably applies a certain amount of pull to the toes. On the right is a boatbill which rests on both legs.



PIKE RESTING MOTIONLESS IN THE STILL WATERS OF THEIR AQUARIUM

It is still debated whether fish may be said to sleep as we understand sleep, but certain fish spend many hours almost motionless. Of these a familiar case to all who have watched rivers and lakes is that of the pike. This voracious fish will move out of the strong water in mid-stream and make for some quiet lay-bye—at the tail of an island or the mouth of a dyke—and float so still that one might mistake it for a sunk log. In the aquarium at the London Zoo pike may be seen thus, with only their greedy, golden eyes moving now and then.

much at their " camps " that they fall asleep late, and yet are on the wing again before dark when evening comes on.

An Indian vampire the writer once kept appeared never to sleep at all, for whenever he was awake at night he could hear it fluttering about in its large cage, and always found it awake when looked at by day. It may be that such creatures, like owls, which in captivity generally seem to be awake whenever one looks at them, only sleep in snatches, as has been noted in the case of some seals, and it is possible that the long-sailing albatross really dozes on the wing, as pictured in Moore's beautiful lines :

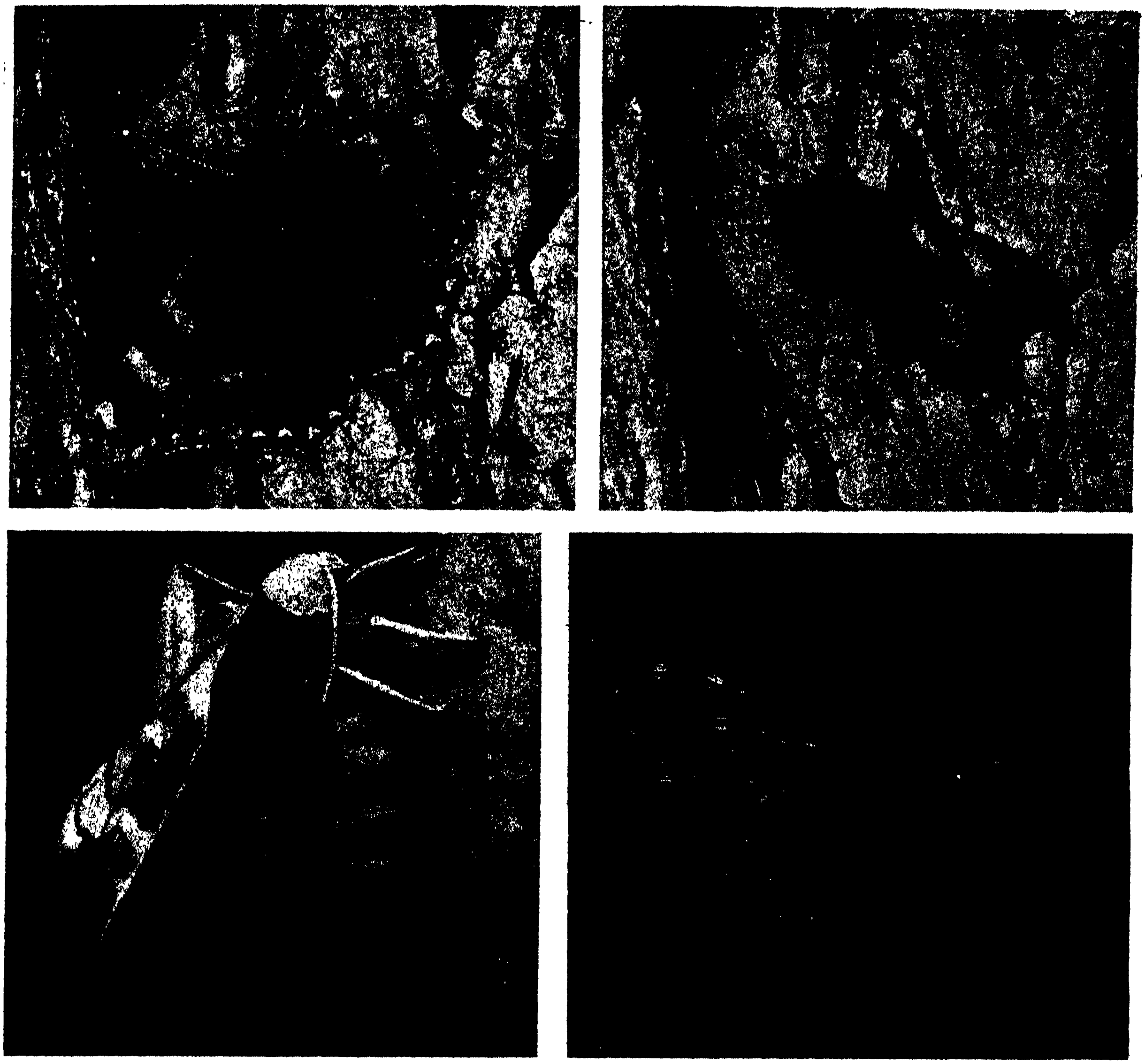
A ruined castle towered so high
That oft the sleeping albatross
Struck the wild ruins with her wing,
And from her wind-rocked slumbering
Started, to find man's dwelling there
In her own silent fields of air.

To return to the bats, a few species with a high northern range migrate south in autumn like birds, and it has been suggested that the reason why they do so is that the northern winter is so long that even a hibernator's endurance could not survive it ; it is true that, except in the case of the pregnant polar bear, there is no hibernation among mammals in the Arctic. The lemmings remain active under the snow, as also does the Alpine mole.

The curious long-tailed bat, whose tail is free from the leg-web and looks like a mouse's, accumulates a mass of fat at its hinder parts as a reserve supply for hibernation ; so do also the little mouse-lemurs of Madagascar, which are the only Primates or relatives of the monkeys which are subject to torpor, which is limited to a few groups in mammals.

In reptiles and amphibians, however, it is very common, and universal in climates with a cold winter ; the more aquatic kinds seek the water at this time, and bury themselves in the mud ; what little flicker of respiration that goes on being conducted, no doubt, through the skin, at any rate in the case of frogs which are known to be skin-breathers.

That the common European water-tortoise, so well known to pet keepers, can go for long without breathing, and even bear freezing, was proved to the writer by a specimen of his which wintered in a stone flower-basin sunk in the ground and containing about six inches of water ; and on one occasion it must have been frozen, as the water became a cake of ice Yet it survived and suffered in no way.



H. Bastin

WING POSITIONS OF MOTH AND BUTTERFLY WHEN RESTING IN THE SUN

The lower left-hand photograph is of a poplar hawk-moth, slightly enlarged, resting its huge fat body from the labours of flight. Next it (bottom right) is a specimen of ageronia, a South American butterfly which much resembles the irregularities and lichen on tree trunks. This butterfly rests with its wings open, whereas most butterflies keep their wings closed when resting. Moths, on the other hand, when asleep, open their wings out flat. The upper photographs show the small tortoiseshell butterfly (left) sunning itself and (right) in its sleeping position.

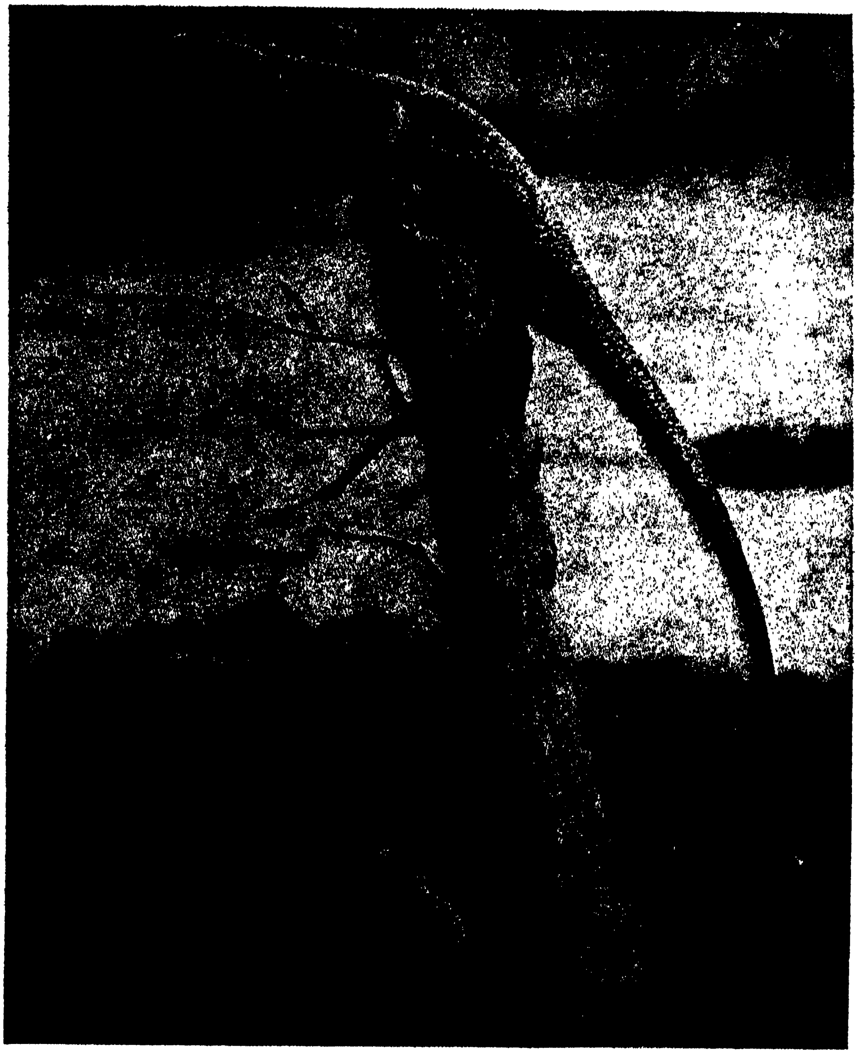
An opposite example of endurance was shown by an Eastern water-tortoise, the box soft-shell, which was found by a well-known Indian sporting naturalist, Mr. W. K. Dods, aestivating at a little distance below the surface of a previously-flooded plain which at the time was being baked by the sun so thoroughly that it was painful to walk over it even in shooting boots.

An instance of a peculiar and very aquatic frog, inhabiting a warm country liable to drought, nevertheless remaining active all winter under very abnormal conditions of temperature occurred in London during this century, when an East-end dealer got a number of the curious and highly aquatic African claw-footed frogs, and kept them in an outdoor unheated shed in a tank, where they not only did not hibernate, but fed; for some that died were devoured by their companions, the claw-footed frog differing from others in readily eating dead food.

Fish are usually killed, like air-breathing vertebrates, if frozen, but this is not the case with the Alaskan blackfish Dallia, which also inhabits Eastern Siberia. It lives in sphagnum-grown ponds, being content with the merest wetting of water, and undergoes freezing in winter with perfect equanimity. The Alaskan natives use it freely for food, though it is only about as big as a gudgeon, and it is found that specimens which have been stored frozen in baskets for weeks will be as lively as ever when thawed. The fish is also fed to dogs, one of which animals has been known to swallow the frozen fish and vomit it up alive, thawed out by the warmth of his stomach and no doubt provoking ejection by its activity.

Insects commonly become torpid when the temperature falls at all markedly, and many will not even fly when the sun is overcast, as is very noticeable in the case of some butterflies; the writer, however, once saw in a London street a Large White butterfly flying about and feeding at the flowers in window-boxes on a dull drizzly day. This, however, was a very exceptional case and it might almost be said that the butterfly's official hours are ten to five, the rest being spent in repose.

He has also seen the Painted Lady butterfly active on an autumn day when the temperature was decidedly cold, though the sun was bright. The few hibernating butterflies may occasionally be tempted out on warm days, and the writer has found that captive Red Admirals will live for weeks in winter even, if periodically awakened by warmth and fed, this butterfly being quite willing to move and feed, when the sun is not shining, and even fighting over food by flapping like an angry pigeon and pawing ridiculously with its tiny legs.



Natural History, N.Y.

BEARDED DRAGON IN REPOSE UPON A STUMP

When in repose, the bearded dragon lies with its " beard " as we see it above. But under the stimulus of alarm or anger this appendage is expanded, making this already hideous creature more frightful still. It is a little under two feet long, as a rule, and is very fond of basking on tree stumps. When photographed this particular " dragon " was at peace with all the world.

Butterflies and moths differ much in their positions of repose, the butterflies usually resting with wings closed over the back, exposing the under surface, while the moths draw their wings down to their sides or spread them out flat. Skippers, which are one of the groups forming the transition between butterflies and moths, exhibit a compromise when in repose, keeping the fore-wings erect and spreading out the hinder ones horizontally.

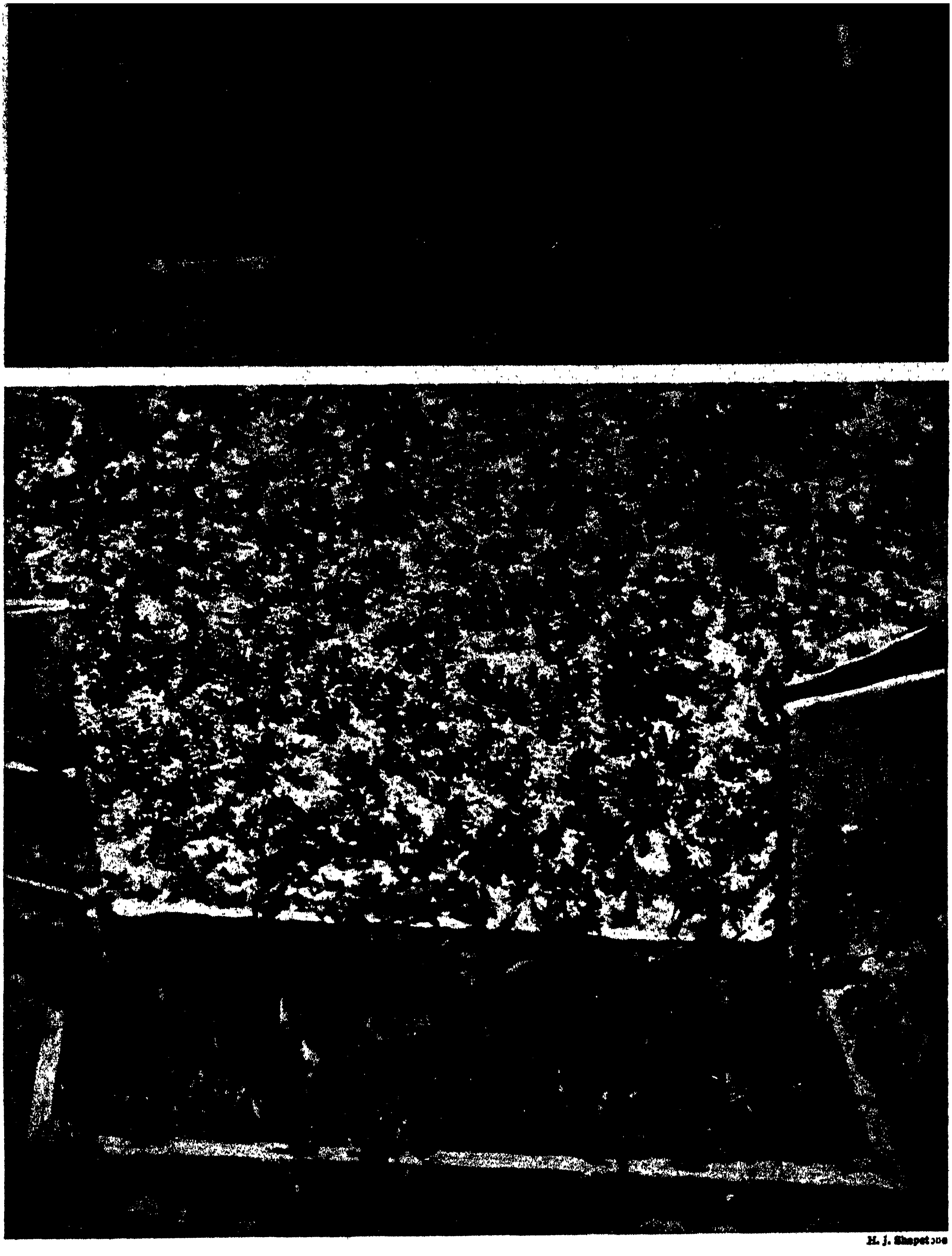
The different groups of dragon-flies exhibit a very similar difference in their repose positions; the larger and stouter-built kinds spreading out their wings horizontally, while the slim " demoiselles " fold their wings in butterfly fashion with the inner surfaces applied together, and the outer exposed.

The instinct for resorting to a given resting-place even by day is well known by the Purple Emperor which likes a certain twig high up on an oak tree, and, in fact, his special attachment to this gave almost the only chance of capturing him when, his taste for strong-smelling bait not having been discovered, his human enemies used to pursue him with preposterously long-handled nets.

The pupa stage of insects, in which this takes the form of a helpless chrysalis incapable of anything but a wriggle, is a period of absolute rest as far as the external world is concerned, but there is, at this time, a regular revolution going on in the creature's interior, for insects which pass through such a stage may almost be said to die and undergo dissolution and emerge in a resurrection. The chrysalis really is, as Shelley said

> An ante-natal tomb
> Where butterflies dream of the life to come

for the chrysalis stage sees the wonderful process of histolysis, or tissue-dissolution, in which the organs of the caterpillar break down into a sort of creamy matter to be reconstructed into those of the imago.



H. J. Shepstone

DEALING WITH THE TERRIBLE LOCUST MENACE IN SOUTH AFRICA

In South Africa hundreds of thousands of pounds worth of damage has been done by locusts periodically. Methods of dealing with this pest have now become standardised and one of the most effective is illustrated in this page. Locust traps (lower photograph) are made by sinking a box or a pit in the path of the locusts when they are in the nymph or flightless stage and guiding them into the trap between two converging lines of obstacles. The upper photograph shows both men and women turned out to drive the crawling host.

Chapter C

Insect Enemies of Man's Industry

By Dr. S. A. Neave

Assistant Director, Imperial Bureau of Entomology

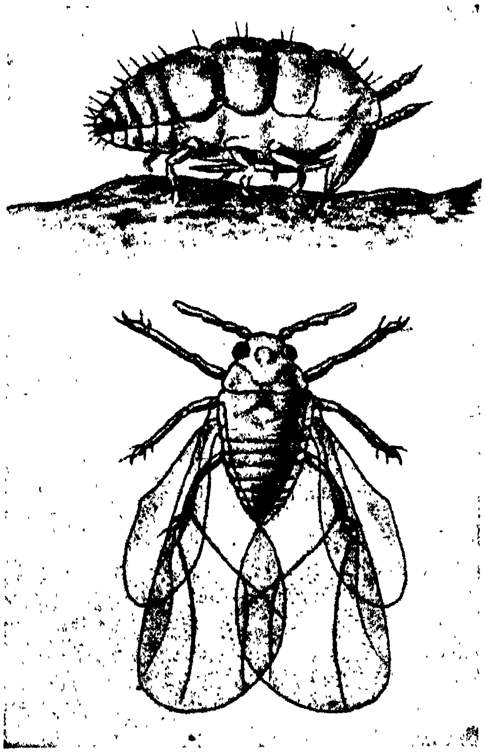
THE [illegible] that insects are perhaps the chief [illegible] competitors of mankind has only [illegible] recently received recognition in the history of civilization. Indeed it is doubtful whether primitive man took any interest in insects at all except for the honey he obtained from bees and that some of the larger caterpillars and beetle larvae provided him with toothsome morsels. Even at the present day the natives of Central Africa are chiefly interested in insects from this standpoint and scarcely recognize them as enemies that take toll of their crops or affect their health.

Nor is this surprising since the fact that certain insects occur in such numbers as to reach the status of pests is entirely due to the action of mankind in upsetting the balance of nature by cultivating great quantities and large areas of one particular kind of plant. Consequently it is not until agriculture is widely and extensively practised in any country that insects become serious and obvious competitors of man so far as his food supply is concerned.

Under modern conditions, however, the most cogent insect problems, at least in more civilized countries, are concerned not so much with the native species, though these are serious enough, but with those that have been accidentally introduced from elsewhere. Everyone knows the result of importing the rabbit into Australia, and this is a classic instance of what may happen when a creature is introduced into a new country where the climate may be more favourable to it and where its natural enemies are few or non-existent. With the constant interchange of foodstuffs of all kinds and many other animal and vegetable products that occur under modern conditions, it is not at all surprising that many insects have escaped from their native country into new homes and have caused untold and incalculable losses. Though nearly every civilized country now maintains expensive quarantine services aimed at keeping out these invaders, it is a moot point whether they will be permanently successful, and the fact has to be faced that it is highly probable that every dominant insect pest will ultimately spread over the whole of its potential geographical range.

The most modern method of dealing with these invasions is to endeavour to introduce into the invaded country one or more of the parasites of the pest concerned which normally keep down its numbers in its original home. For it has been found that the absence of these natural enemies is in many cases an important cause of its huge increase in the country it has invaded. Such parasites are highly-specialised creatures and are usually only able to live in a single host; scarcely any risk therefore exists in establishing them in new countries.

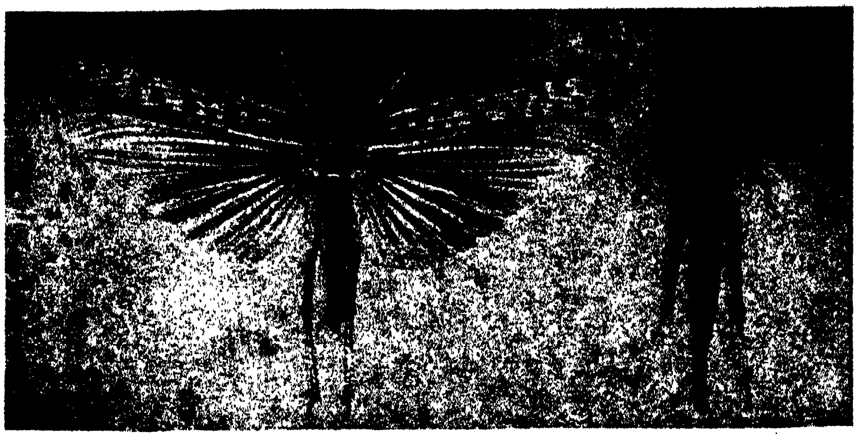
In order to give some idea of the enormous losses involved and the vast sums that have had to be expended in dealing with these imported pests, we may now take some concrete instances. The continent that has suffered most in this respect is probably that of North America. This is, however, only in accordance with expectation. Agriculture in Europe has been carried on for many centuries, and a new equilibrium between the crops and the insect pests has been partly attained. In North America not only is agriculture relatively recent, but it has been carried on on a vast scale, and very large areas have been devoted to single crops, thus favouring the propagation of a particular insect in great numbers. Not only, therefore, have some of the indigenous insects been provided with an almost unlimited food supply, but invaders from Europe have, in many cases, had opportunities of spreading that did not obtain in their native land.



DESTROYER OF THE VINES

About the year 1863 the vine aphis or phylloxera was introduced into Europe from North America, doing enormous damage. In 1878 an international convention had to be called to deal with the pest.

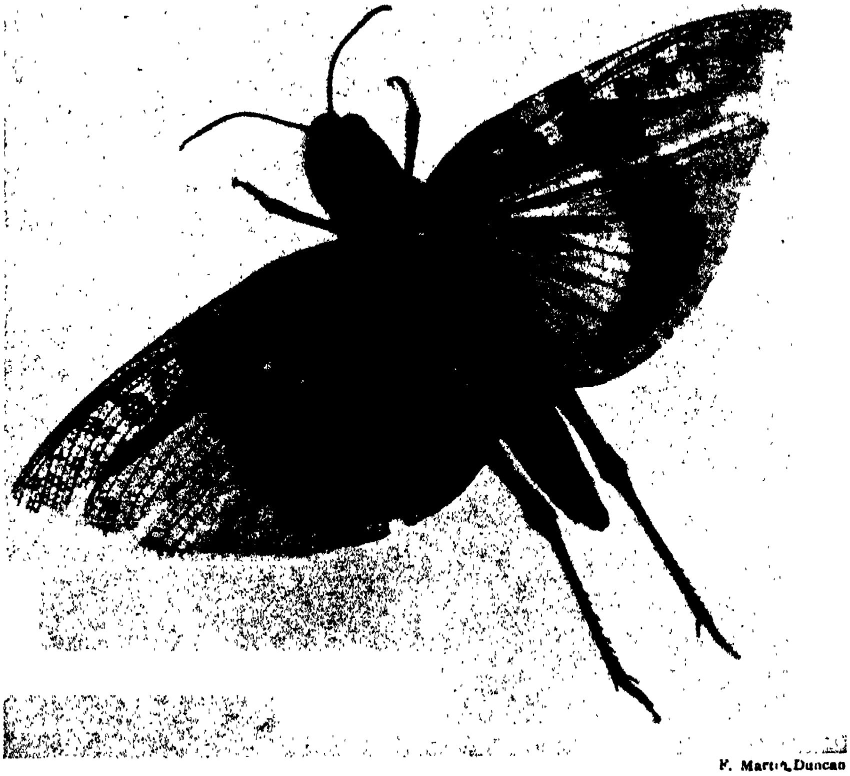
Europe itself has not wholly escaped from American invaders. The dreaded phylloxera has spread throughout the vineyards of the Continent since the middle of the last century, and the woolly apple aphis (*Eriosoma lanigerum*) is now almost universal in European orchards. A more recent example is the invasion of the potato fields of south-western France by the Colorado potato beetle (*Leptinotarsa decemlineata*). This last pest made its appearance in Germany just before the War, but it was stamped out by the extreme



H. Bastin

measures taken by the authorities, who turned out troops to deal with it! It was even suggested during the War that this beetle might be dropped from aeroplanes on to the German potato fields. This novel form of warfare, though it would have been quite practicable, would, however, only have ultimately resulted in permanently affecting the crops, and therefore the price of potatoes throughout the whole Continent.

In North America itself many striking examples occur of the enormous damage and loss that have been inflicted by insect pests. Costly routine measures against some of the indigenous ones, such as the cotton bollworm (*Heliothis obsoleta*), the San José scale (*Aspidiotus perniciosus*), the chinch bug (*Blissus leucopterus*), the various caterpillars known as army worms, and the many species of aphids that infest fruit and grain crops, such as the Southern grain louse (*Toxoptera graminus*), have in recent years become a commonplace in American agriculture.



F. Martin Duncan

WINGED LOCUSTS AS THEY FLY TO NEW FEEDING GROUNDS

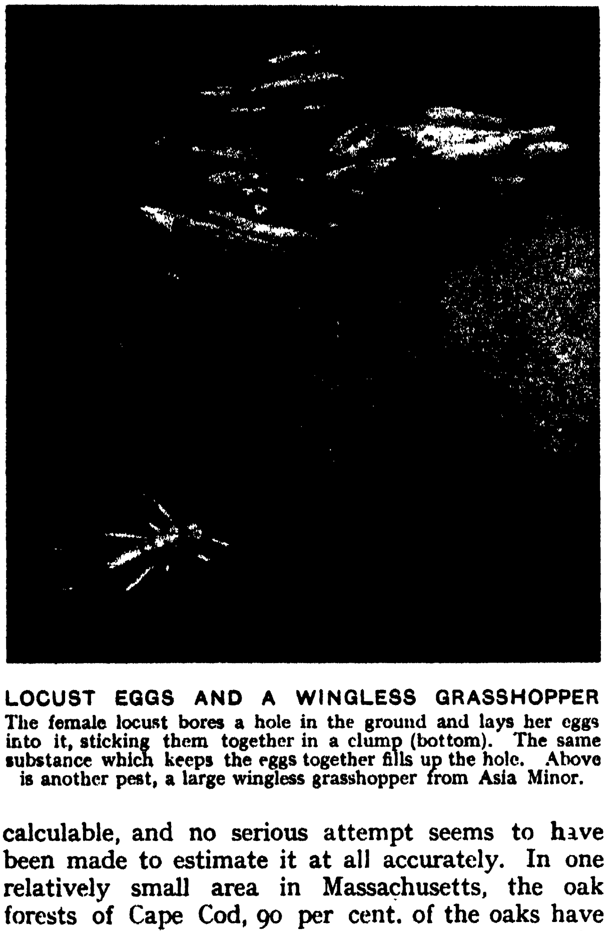
The locust is a species of short-horned grasshopper belonging to the family Acridiidae, and though the term locust is applied to insects of other families, even the cicadas of America, strictly speaking only members of the short horned grasshopper family should be called locusts. Here are (bottom) a locust as in flight, and (top) migratory locusts with wings open and closed.

But serious though these pests are, an even more alarming menace to that country is presented by some of the insects that have been imported from Europe and elsewhere.

Probably the best known of these is the gipsy moth (*Porthetria dispar*). On this side of the Atlantic, this moth is chiefly prevalent in Central Europe, where it has long been known as a pest in the forests. It is fortunately an uncommon insect in England. It first appeared in North America in Massachusetts about 1868. About twenty years later it had become so abundant and injurious that the Legislature of that State found it necessary to appoint a special commission to study the situation. It is now generally distributed over a very considerable percentage of the New England States, and though some isolated infestations have been exterminated by the energy of the authorities, the pest still appears to be spreading. The war on this enemy and the brown-tail moth (*Nygmia phaeorrhoea*), another imported pest of the same character, is, however, still in progress, and the methods of exterminating it continue to be improved upon. These have been considerably assisted since about 1905 by the introduction of numerous parasites and predaceous insects, chiefly from Europe, but also from Japan.

The direct cost of keeping this moth within bounds is stupendous. A calculation made in 1922 estimated that at that time the New England States had expended over four million pounds sterling in their efforts to control it. In Massachusetts alone the expenditure for 1921 amounted to over £165,000, and to these figures must be added the expenses of the Federal Government, which since 1906 has applied its efforts to checking the spread of the enemy into new areas.

Nor is this the only loss to the community that has been inflicted by its presence. The damage done to the forest areas in these States is incalculable, and no serious attempt seems to have been made to estimate it at all accurately. In one relatively small area in Massachusetts, the oak forests of Cape Cod, 90 per cent. of the oaks have been killed, these trees representing 75 per cent of the forest land. It must be remembered that this moth's capacity for increase and for doing extensive damage lies in the fact that its caterpillars are very catholic in their tastes. Though they have a preference for deciduous trees, such as oaks and poplars, they will also attack several conifers and other valuable timber trees. Even where such trees are not killed outright there is a serious retardation of growth and consequent loss in the production of marketable timber.

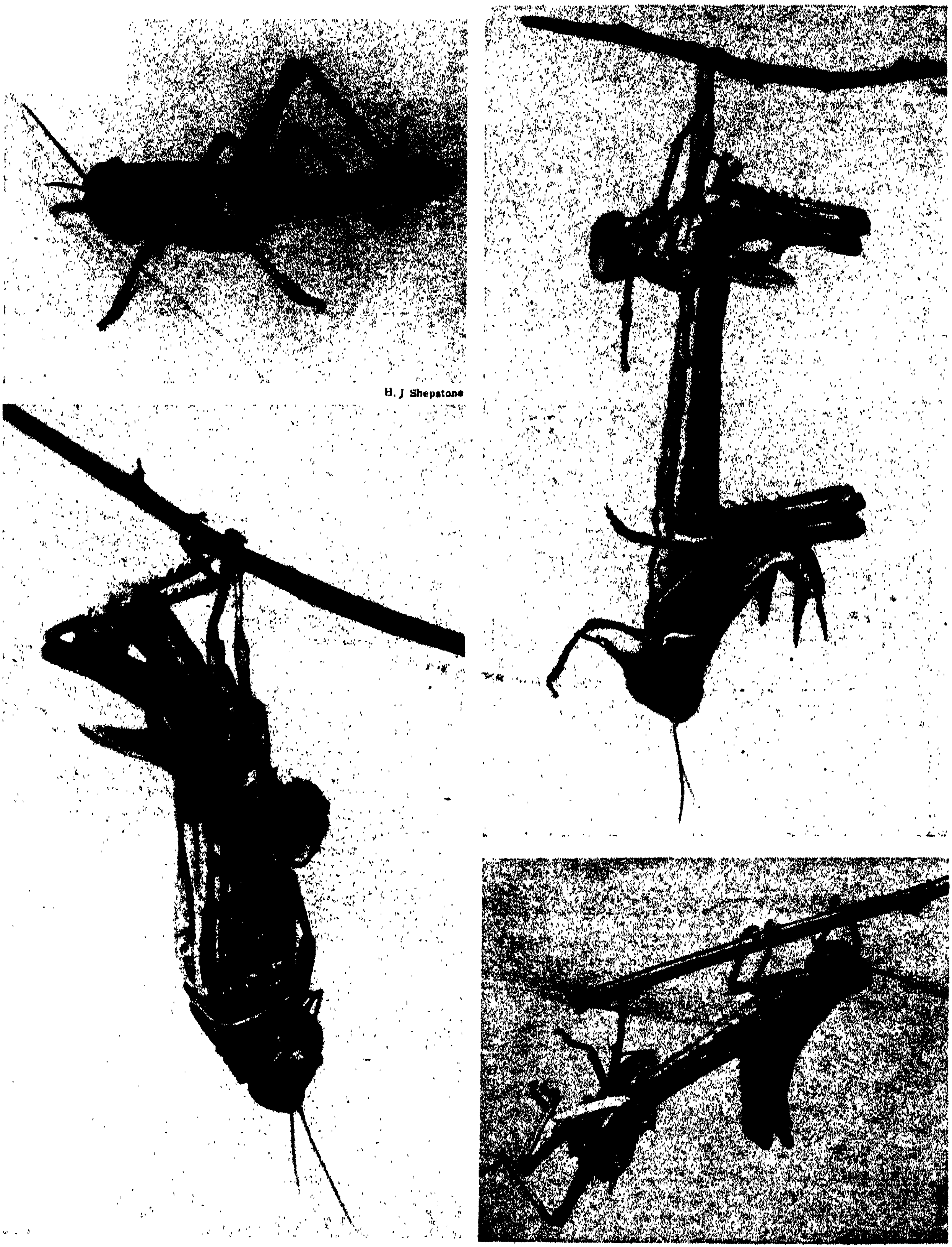


LOCUST EGGS AND A WINGLESS GRASSHOPPER
The female locust bores a hole in the ground and lays her eggs into it, sticking them together in a clump (bottom). The same substance which keeps the eggs together fills up the hole. Above is another pest, a large wingless grasshopper from Asia Minor.

In spite of all this, and though the best known to the public at large, the gipsy moth is perhaps not the most dangerous enemy that America has to face at the present time. Within the past ten or twelve years the so-called European corn borer (*Pyrausta nubilalis*), a small moth that bores in the stems of maize, sorghum, and similar plants, has been introduced from Europe, and is spreading with most alarming rapidity. So menacing is the situation that in the spring of 1928 the Federal Government voted no less than two millions sterling toward investigations and other measures for checking its spread. Vast though this sum is, it is clearly not more than the situation demands, when we remember that maize is one of the chief food crops of the United States.

This country has also had to face the attack of most dangerous invaders from the South. The Mexican cotton boll weevil (*Anthonomus grandis*) now causes tremendous annual losses to cotton, and has apparently increased the cost of producing this crop. The Mexican bean beetle (*Epilachna corrupta*), a kind of leaf-eating ladybird, is steadily spreading, and doing great damage in the Southern States. An even more alarming enemy is the notorious pink boll worm (*Platyedra gossypiella*). This is the caterpillar of a small moth which enters the cotton seed and is consequently very liable to be transported about the world in spite of all precautions. It is still a matter of dispute as to where this pest originated, but it has undoubtedly occurred in India for a very long time, and it is most probably indigenous there. Outside that country it first began to attract attention in Egypt about 1912. Since then it has spread rapidly, and it now occurs in most of the tropical cotton-growing areas of the world. A few years ago it crossed the Mexican frontier into the Southern United States, and the most strenuous efforts of the authorities to eradicate it have not yet apparently been entirely successful.

Canada is also menaced by some of these enemies, and a recent account of the situation respecting the spruce budworm (*Tortrix fumiferana*), another European invader, states that this moth has already

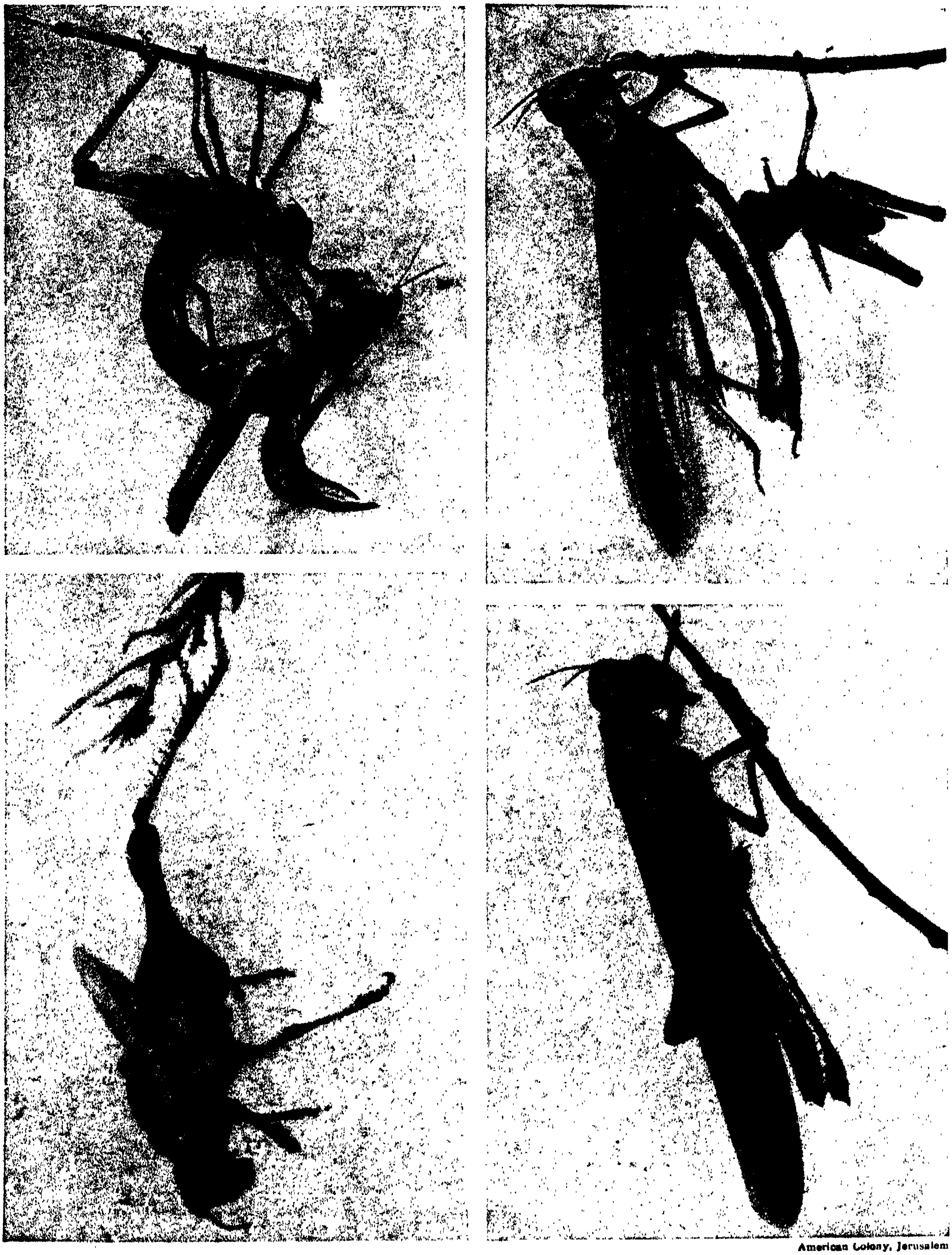


H. J Shepstone

American Colony, Jerusalem

LAST STAGES IN THE DEVELOPMENT OF A PALESTINE LOCUST

Adolescent locusts undergo a series of moults, usually six between the time of emerging from their eggs and becoming fully developed flying insects. Here we see opening stages in the process of the final moult. The nymph has little, semi-developed wings which we see in the top left-hand photograph, folded in membranous cases which themselves resemble tiny wings. Hanging from a twig it begins to shake itself free of the old skin (bottom left), gets its hind legs free (top right) and then comes two-thirds of the way out (bottom right).



American Colony, Jerusalem

HOW THE DESTROYER ADDS WINGS TO ITS POWERS OF DESTRUCTION

Rapidly curving its new, lithe body (top left) the emerging locust writhes its way out of its old skin wherein it was doomed to be always on the ground. The discarded nymph case (bottom left), hollow throughout from the very tips of the antennae, is left hanging from the twig which it still grips with its hollow, lifeless legs. Having successfully completed the business of emergence the locust then proceeds to dry its wings very carefully, its long hind legs smoothing out the creases meanwhile (top right). At last all is ready (bottom right).

SPECIMENS OF THE SOUTH AFRICAN AND PALESTINE LOCUST COMPARED

It is in South Africa that the locust has made the greatest depredations, destroying in one year a million pounds worth of potential goods. It is in the nymph or crawling stage that the damage is mostly done since, when the insects can fly, it is usually the dry season when there is not so much to destroy. It is, of course, its terrible power of being able to travel from place to place over considerable distances that makes the locust the most appalling of pests. Below is a South African locust, and above a Palestine locust.

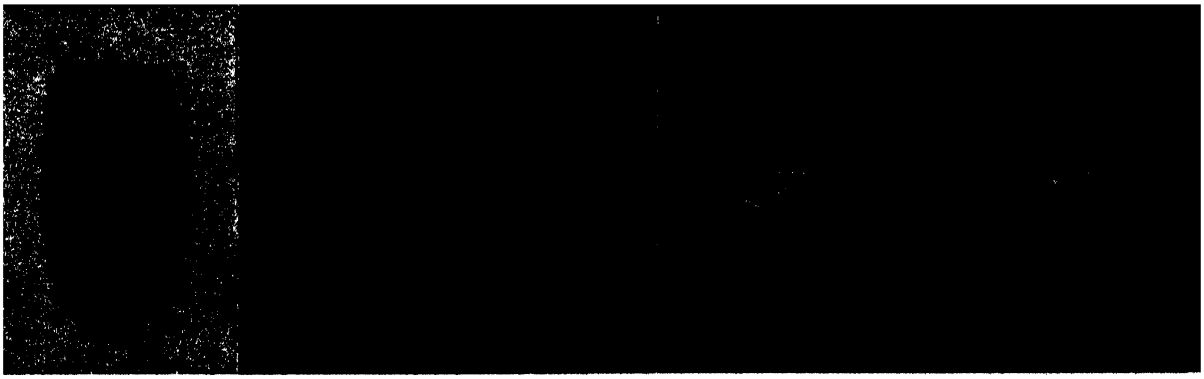
AMERICAN LOCUSTS, THEIR EMPTY EGG SHELLS AND THEIR ATTACK ON TREES

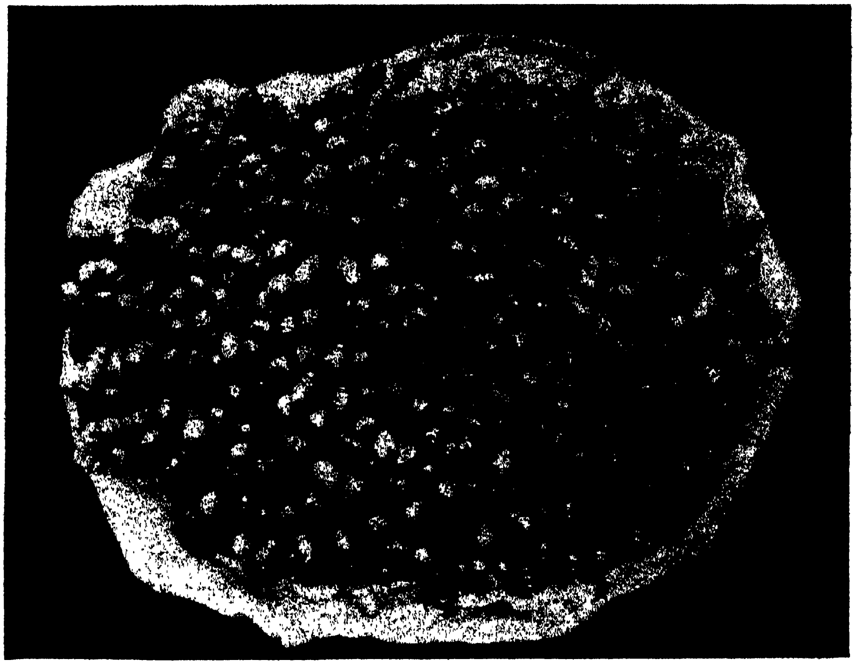
In the United States of America, as well as in Canada and South America, locusts have caused great harm to crops. Above we see some locusts of the true or grasshopper type, for it should be borne in mind that in America the cicada has been sometimes referred to as a locust. The lower photograph shows empty shells from which young ones have emerged while above we see insects attacking (left) the bark and (right) the branches of trees. It has been found that deep ploughing is a very efficacious way of dealing with the plague.

destroyed 150 million cords of pulpwood in parts of Quebec and the Maritime Provinces.

Though the above examples relate to insect invaders in North America, many other cases exist in other parts of the world. Within recent years very serious damage has been done to the coffee plantations in the Dutch East Indies and also in Brazil by a small beetle, the coffee-berry borer (*Stephanoderes hampei*), the original home of which is in Central Africa. Coco-nuts, which are the most important crop in the Fiji Islands, were recently threatened with extermination by the caterpillars of an imported moth. Fortunately the introduction of a parasitic fly from Malaya that attacks it has met with marked success, and there are good grounds for hoping that this pest is now under control.

Such instances of outbreaks of imported pests in tropical and sub-tropical countries are naturally less numerous than those in temperate zones, among which an interchange of commodities has gone on for so much longer. There is, however, every reason to think that as direct trade between the regions within the tropical belt increases, they will become





H. Bastin

HORSE-BOT, A HORRIBLE PARASITE AND ITS LIFE STORY

The horse-bot fly (top right) lays its eggs on the horse's fore-leg, which consequently begins to irritate. The horse licks itself and thus the eggs get transferred to the tongue and so swallowed. The larvae (top left) develop in the stomach (bottom) and eventually pass through the food canal and fall to the ground, where pupation takes place (top centre).

much more numerous. Indeed, as stated earlier, it may well be that, in spite of quarantine measures, all the more important pests of our staple crops will ultimately occur wherever the climate permits of their existence. It must be remembered also that quarantine measures themselves frequently cause serious disorganization of trade and may seriously affect commercial relations between different countries. For instance, great disturbance to Spanish trade has been created during recent years by an embargo on the importation of Spanish grapes into the United States, owing to the fact that they may be the means of introducing into that country the Mediterranean fruit-fly (*Ceratitis capitata*), a very dangerous pest in warm climates.

As regards the insects that transmit disease to man and animals, the instances of serious outbreaks due to imported insects are, for obvious reasons, not so striking, though many of them are of great and far-reaching importance. The ones most likely to invade new countries are those that are attached to their host either permanently or at least for long periods. Thus, some of the ticks that infest and convey disease to domestic animals have become cosmopolitan. The same applies to the "sheep tick" or "ked" (*Melophagus ovinus*), which is really a degraded wingless fly. Ticks themselves, though not true insects, are generally treated as coming under the problems dealt with by an entomologist. Other blood-sucking insects of outstanding economic importance are fleas. One of them is the principal carrier of bubonic plague in man and rats and, though probably originally confined to the Oriental region, has now been spread by shipping into many of the seaports of the world. A quite recent instance of an invasion by a disease-bearing insect may be seen in the island of Barbados, which, until the last year or two, has always enjoyed immunity from malaria. One of the malaria-carrying Anopheline mosquitoes has, however, now made its appearance there, having presumably been imported in shipping, and numerous cases of the disease have occurred.

No serious calculations have been made as to the huge economic loss due to insect-borne diseases in man and domestic animals, such as malaria, sleeping sickness, plague, yellow fever—to mention only a few. It is, however, obvious that any community, a high percentage of the members of which are annually incapacitated for some weeks or months by a disease like malaria, must lose heavily in efficiency and earning capacity.

H. Bastin and T. J. Ward

TWO OF THE PESTS THAT INFEST SHEEP: THE KED AND THE NOSTRIL FLY

The so-called sheep tick or Ked is really a wingless fly which lives in the thick fleece of the sheep's wool and sucks blood. Here (bottom right) we see a ked's head, much enlarged, and the two small photographs to the left of it show the whole fly. Dipping when the wool has been sheared is the remedy. Above are five photographs of the sheep nostril fly. From left to right they show: a full-grown grub; pupa cases, one being opened to show pupa; the fly itself. The larvae are deposited on the noses of sheep and work their way inwards.

Enormous damage is also done by insects which, though not carrying disease, inflict direct injuries on domestic animals. Thus the warble flies in America are said to cause a loss of from ten to twenty millions sterling per annum owing to the damage they do to the hide industry, without reckoning a reduction of from 10 to 25 per cent. in the yield of milk. The blow-flies that attack sheep in Australia are calculated to cause an annual loss of three to four million pounds. Sheep bot-flies also do great damage in that country.

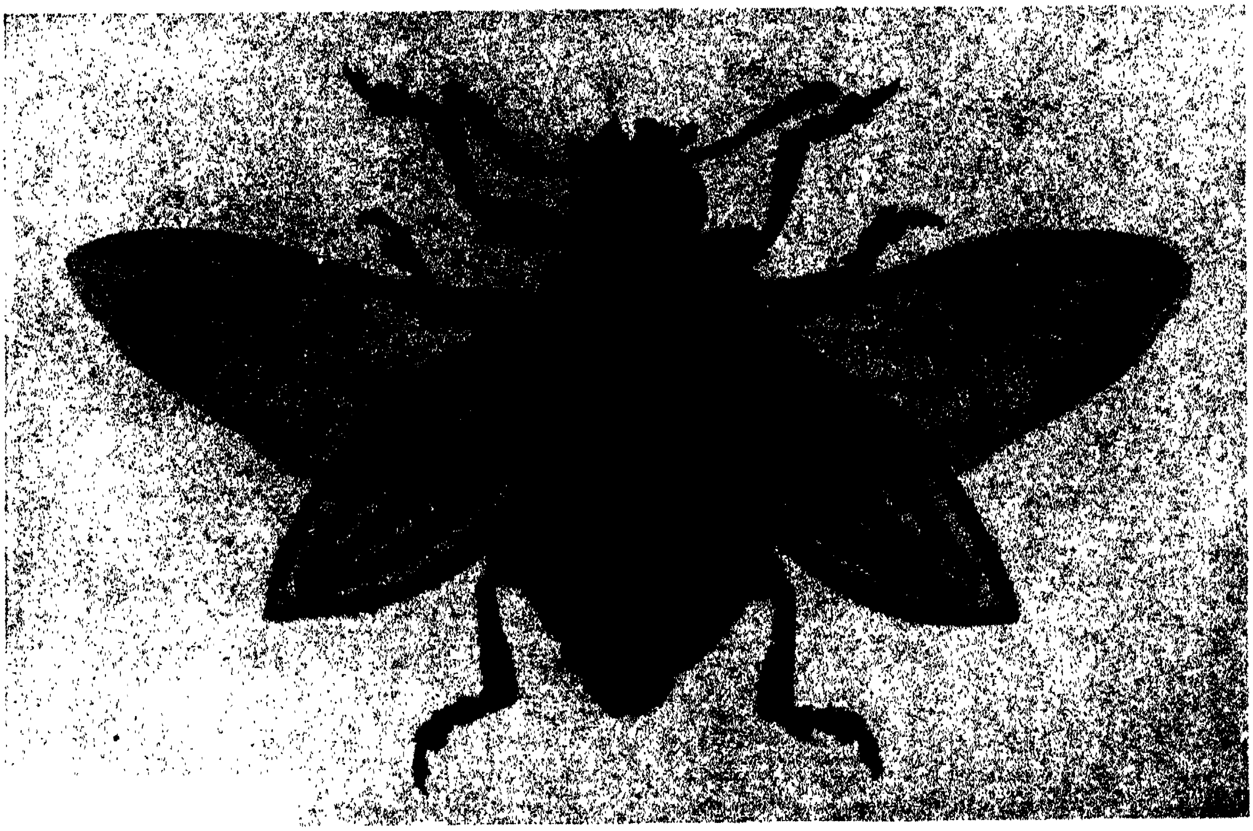
Instances of the damage done to man and his multifarious enterprises might be multiplied almost indefinitely, and to mention them all in detail would be quite beyond the scope of this chapter. Much might be said about the gigantic losses all over the world due to the now nearly cosmopolitan beetles and moths that destroy a high percentage of stored cereals, pulses, cocoa and other foodstuffs, to say nothing of those infesting timber, hides and indeed all sorts of animal and vegetable products.

Though no accurate figures for the world as a whole are available, the total annual losses due to insects in the United States alone have been estimated to reach £450,000,000, and the figures for other parts of the world are proportionate to this. To these figures must be added the annual cost of maintaining the entomological services. These reach to nearly a million sterling in the United States, and the British Empire is at present spending about a quarter of a million in routine work. Special emergencies sometimes involve much larger sums, and a bad locust year has before now cost South Africa alone nearly half a million sterling.

It has been calculated that a conservative estimate of the world loss of agricultural products alone from insects is at least ten per cent, and probably a good deal more in tropical countries. In other words

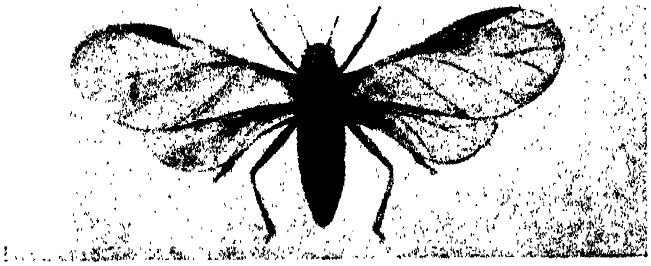
Larva of the Colorado beetle

Colorado beetle larvæ feeding

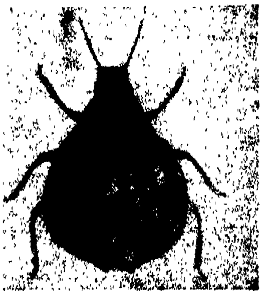


The Colorado beetle with its wings extended

Colorado beetle



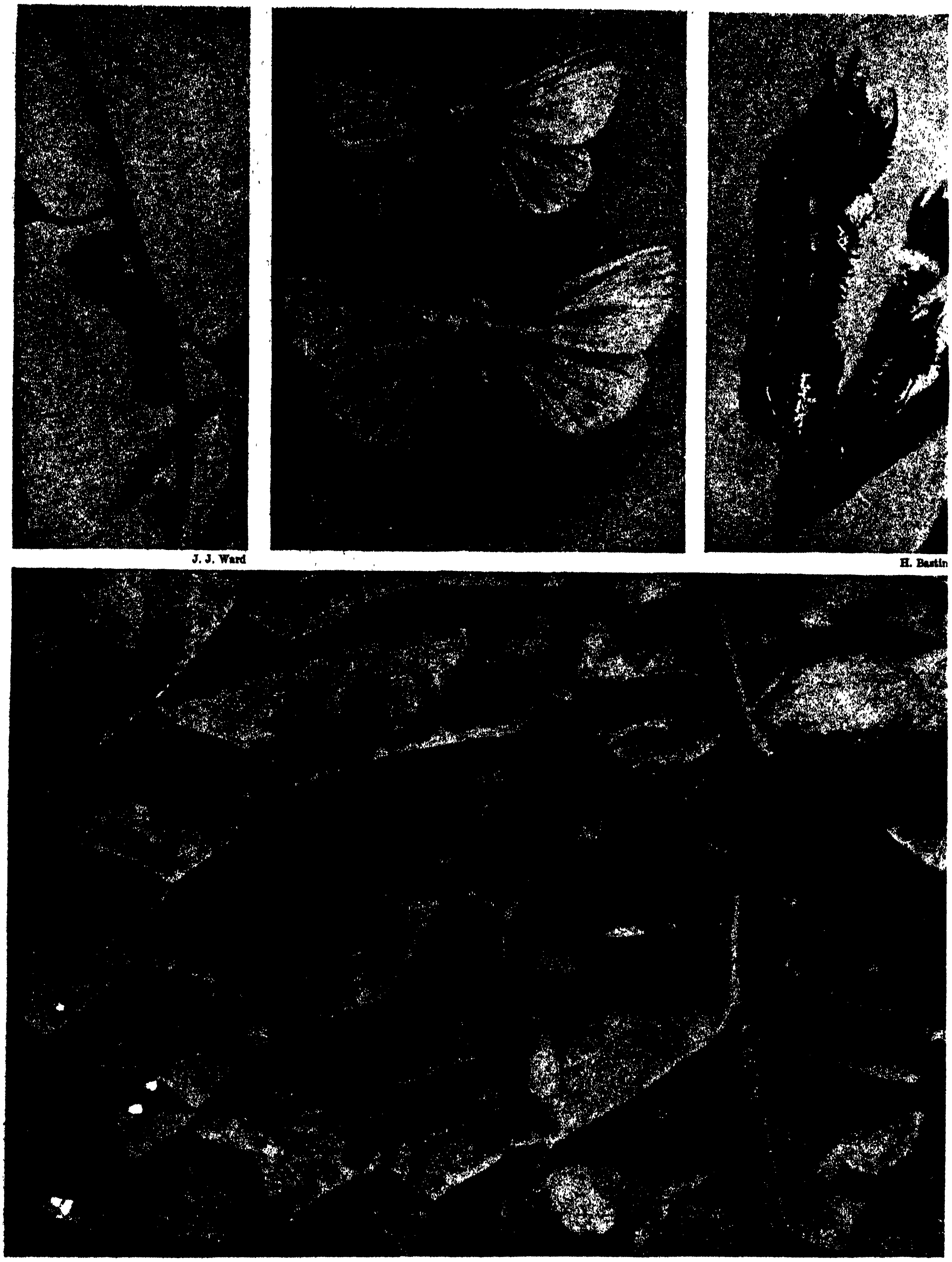
Winged form of woolly aphis



Wingless female aphis

INSECT INVADERS FROM AMERICA THAT HAVE DONE VAST HARM

When an insect pest is transferred from its normal habitat it often happens that its natural checks—other insects and birds—are absent from the particular part of the world to which the pest has been introduced. Also, suitable food may be unusually plentiful, for instance, where there are large areas of crops. Thus it has been with the woolly apple aphis (bottom centre and right). The Colorado potato beetle became transported to Europe just before the War. Photographs, enlarged to various degrees, by J. J. Ward and H. Bastin.

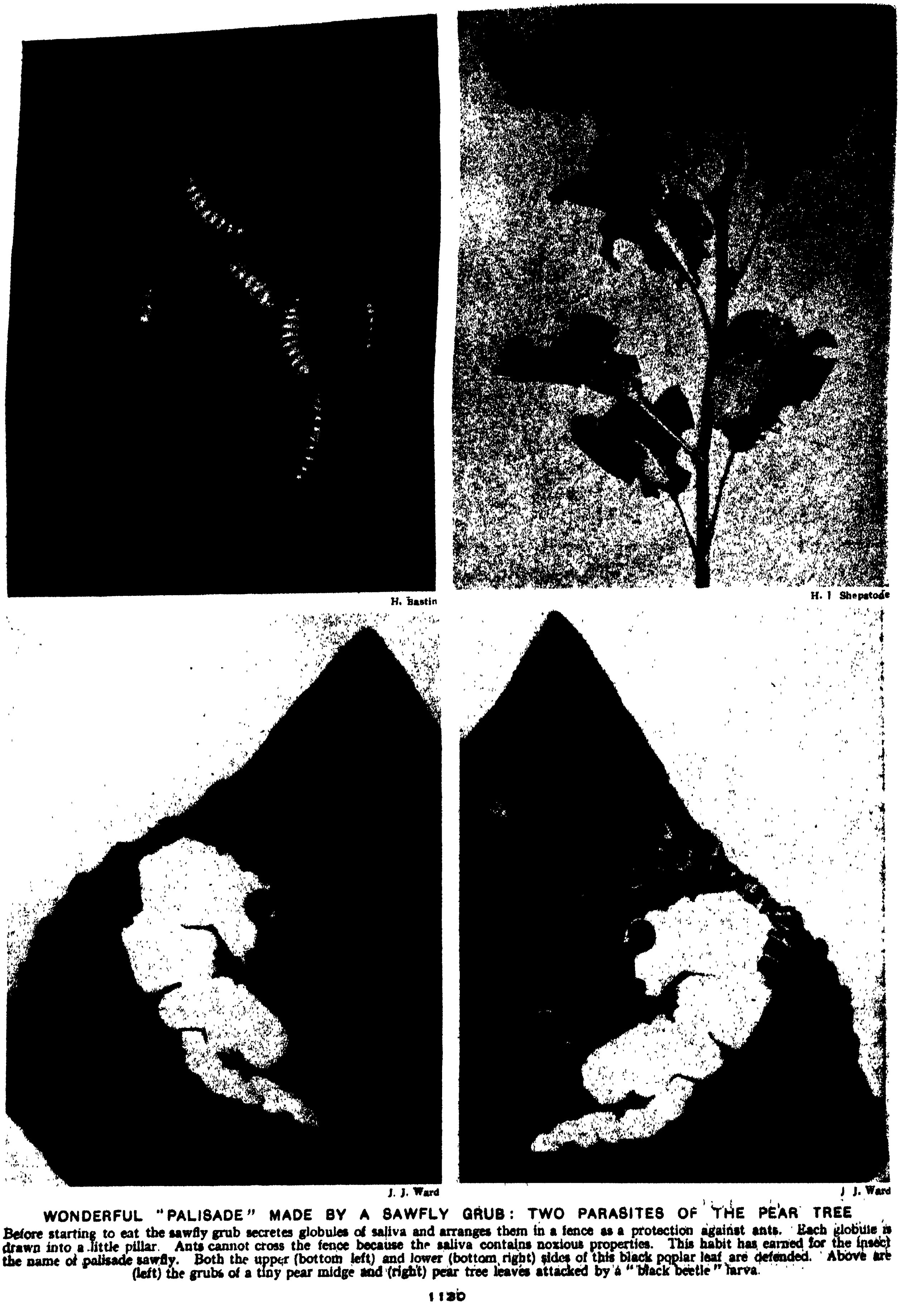


J. J. Ward

H. Bastin

SOME OF THE LITTLE CREATURES THAT COME AS A PESTILENCE TO FLOWER AND KITCHEN GARDEN

All during the warmer days of the year when flower and kitchen gardens are in their full bloom a huge hidden system of destruction is going on, so that what to-day is a promising bud is to-morrow a withering bloom. In the kitchen garden one of the first things noticed is that the big leaves of the cabbages are riddled with holes. This is the work of the caterpillar of the cabbage white butterfly (bottom). Above are (left) a larva and (centre) a male and female of the brown tail moth; and (right) a larva of Hadena oleracea eating a rose bud.



H. Bastin

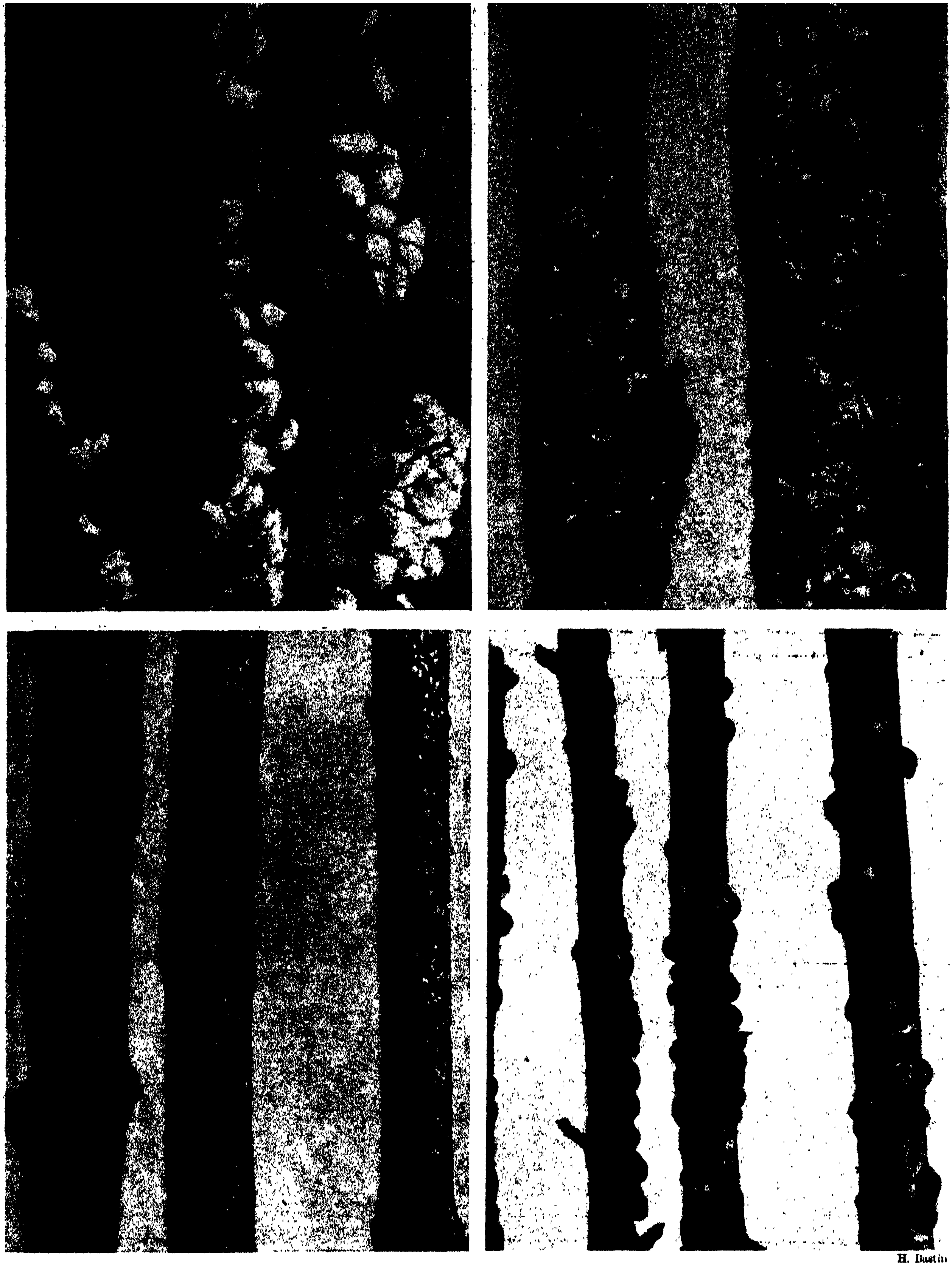
H. I Shepstone

J. J. Ward

J. J. Ward

WONDERFUL "PALISADE" MADE BY A SAWFLY GRUB: TWO PARASITES OF THE PEAR TREE

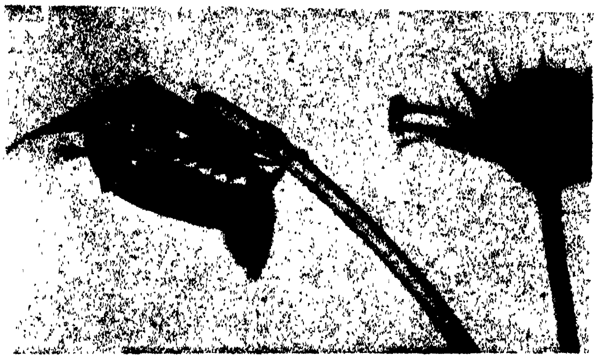
Before starting to eat the sawfly grub secretes globules of saliva and arranges them in a fence as a protection against ants. Each globule is drawn into a little pillar. Ants cannot cross the fence because the saliva contains noxious properties. This habit has earned for the insect the name of palisade sawfly. Both the upper (bottom left) and lower (bottom right) sides of this black poplar leaf are defended. Above are (left) the grubs of a tiny pear midge and (right) pear tree leaves attacked by a "black beetle" larva.



H. Bastin

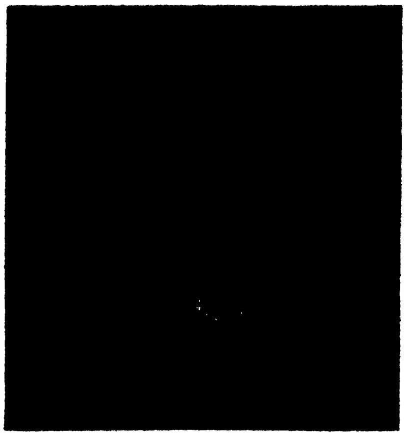
SCALE INSECTS THAT DO IMMENSE DAMAGE IN NORTH AMERICA

When man upsets the delicate adjustments called "the balance of Nature" he is often the worst sufferer by the change, as has been seen in U.S.A. From Europe came a new race of men, sowing vast areas of wilderness with one kind of insect food—wheat or potatoes, or cotton or fruit. As a result the insects multiplied on a corresponding scale. Here are four among the worst offenders: (bottom left) the ash and willow scale; the brown currant scale (bottom right); the cottony cushion scale (top left) and the San José scale (top right)

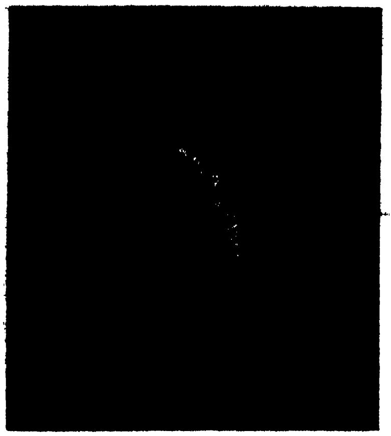


Cockchafer feeding on a leaf

Cockchafer or may-bug, much enlarged



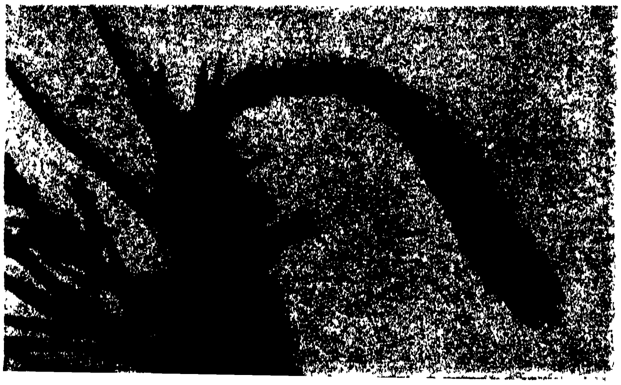
Cockchafer larva among grass roots



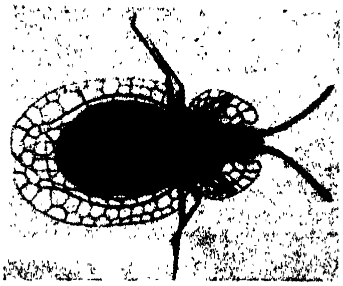
Leather jacket or grub of crane-fly

Larvae of celery fly

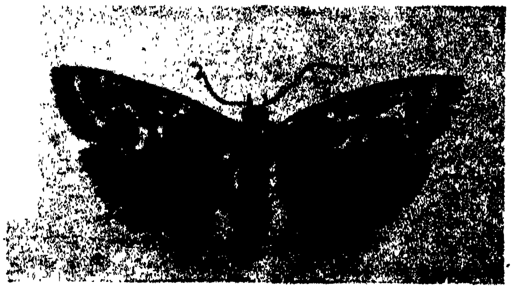
Shield bug on birch catkins



Pine bud moth pupa projecting from damaged shoot



Lace-bug magnified 25 diameters.



Tortrix, twice its natural size

Shield-bug, natural size

DANGEROUS MARAUDERS OF MAN'S TIMBER AND AGRICULTURE

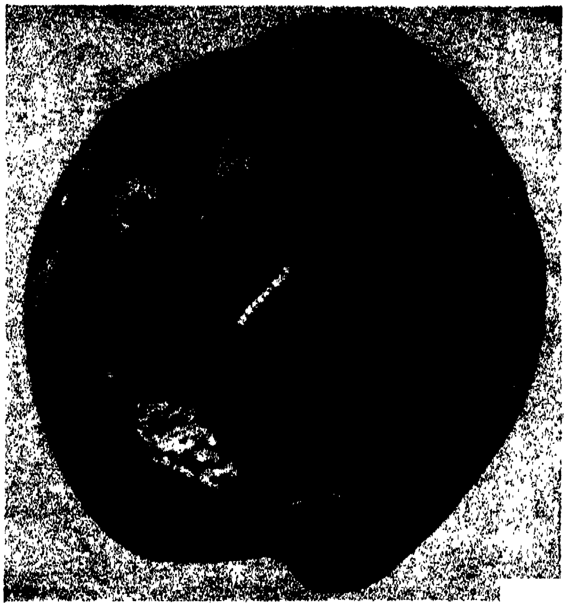
It is not only the sources of man's food that are attacked by insect pests. Some of the most destructive of his insect enemies live by feeding upon timber. The lace-bug (bottom left), for instance, lives on sycamore trees and betrays its presence by giving the leaves a crusty appearance. Another tree pest is the shield bug. There is also the tortrix moth which eats out the shoots of the pine tree. The roots of grass and vegetables are attacked by the leather jacket, and the cockchafer is a destroyer of leaves. Photographs by J. J. Ward and H. Bastin

Scale insect from Trinidad

Orange tree scale insect

Scale insects from Jamaica

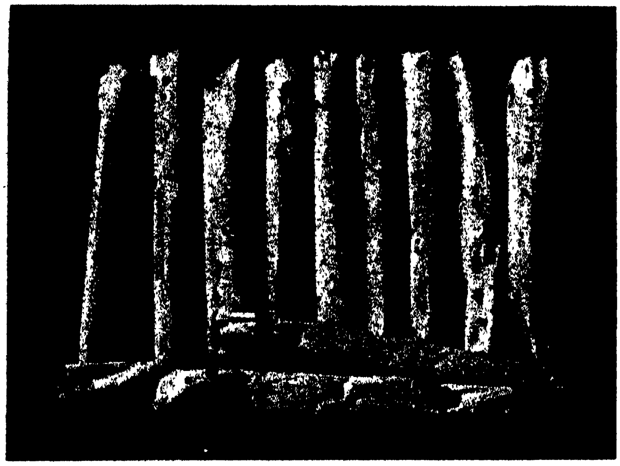
Fruit moth larva in twig



Oriental fruit moth larva at work in peach

Damage to foliage

Coffee berries damaged by coffee beetles



Cigarettes ruined by cigar beetle

RAVAGES OF COFFEE AND CIGAR BEETLES, FRUIT MOTH AND SCALE INSECTS

No matter what the cultivator wishes to grow there seems to be a pest waiting to contest the right of consumption with him. The bottom left-hand photograph shows some coffee berries ruined by the coffee beetle while the three centre photographs are of the oriental fruit moth, which is attacking a peach tree. This moth was first identified in the district of Columbia in 1913, whither it probably arrived from Japan. In America it has learned to eat plums and peaches The upper photographs are of scale insects (magnified) in the West Indies Photos J. J. Ward & H Bastin

Kadel & Herbert, N.Y.

insects by the damage they do to us increase our cost of living by at least this percentage, and their absence would enable man's industry to support a ten per cent. larger population than it does at present. Taking the world population at a round figure of one thousand millions, we should be able, but for our insect enemies, to feed and clothe with our present resources no less than one hundred million more than is the case at present!

It must be clear, therefore, that mankind is continuously engaged in a world-wide war on a gigantic scale; a war that puts into the shade the comparatively feeble attempts that man makes at damaging himself by fighting with his own species and a war that is all the more dangerous and insidious because its very existence is by no means obvious to the average member of the community.

The realization of this situation has been very slow, even among those concerned in ruling the peoples of the world, but a marked change has come over the situation in the last thirty years, and there are hardly any civilized governments that do not now maintain entomological experts attached to their agricultural and medical services. At the end of the last century there was not a single economic entomologist in the government employ in the British Empire. Though there are now some 150 of them, they are a mere handful of the army that is needed.

Even among the public generally the idea that an entomologist is a mildly eccentric individual with green spectacles and a long white beard, who occupies his time in running madly after butterflies, is slowly fading. The modern entomologist must in fact be a highly trained scientific man with a wide knowledge, not only of insects themselves, but of the principles of agriculture, chemistry, medicine and other subjects associated with the problems they involve.

One of the difficulties that has arisen from the relatively sudden realization of the importance of economic entomologists has been that of devising machinery for training them in sufficient numbers to meet the pressing demands for them all over the world. This demand has not yet been adequately met in this country, though some even of the older Universities have begun to realize the great economic importance of entomology.

J. J. Ward

FIGHTING AN IMPORTED PEST IN U.S.A.

Bands of sticky substance check the larvae of the gipsy moth. The lower photograph shows a male (top) and a female, while in the upper photographs we see (left) larvae foiled by a sticky band and (right) a wood. The leafless trees were unprotected by bands.

In conclusion, it should again be emphasised that the insects are among the most formidable enemies of mankind and that an endless and tireless war must be waged against them. Already the problem of feeding our ever-increasing world population is setting the experts thinking seriously. Every year mankind has less and less food to share with the insects.

Chapter CI

The Golden Eagle: King of Birds

By Seton Gordon

Author of "Days with the Golden Eagle"

As I write these lines I have just returned from visiting an eyrie of the golden eagle far up a lonely Highland glen. The eyrie is built upon a rock, at a height of 1,500 feet above sea level, and with a little care it is possible to climb to it.

Three weeks earlier I had visited this nest. The eagle was then sitting closely, and I was able to take my departure without causing her to fly from her eyrie. I returned, accordingly, on the fifth day of May, the date on which the eagle hatched her young last year, hoping to see eaglets in the nest.

Walking quietly round the base of the rock I reached a point from where the eagle's nest was visible. On the crown of the eyrie a dark object was clear, and on looking through my telescope I was glad to see that the eagle was at home. She was brooding very high on her nest, and from this I surmised that the eaglets were hatched. For a few moments she watched me, then walked deliberately to the edge of her eyrie and after standing there magnificently awhile launched out on to the still air. Then from the eyrie came a welcome high-pitched call—the cry of a baby golden eaglet.

No more fitting domain for the king of birds could be conceived. Westward rose snow-covered hills on which sun and shade alternated In the glen beneath a herd of stags was feeding, their young horns showing as small dark knobs against grey heads. On the eagle's rock alpine flowers were all in bud.

The first view into a golden eagle's eyrie is always an exciting moment. There, in its roomy home, stood a tiny eaglet clad in white down and a day or two old at the most. Beside it was a richly-marked egg, from which, later, an eaglet also emerged. In the eyrie lay a grouse and the remains of a very small rabbit. Although it was of such a tender age the eaglet showed marked individuality. A piece of heather beside it annoyed it greatly, and it made repeated pecks at it with its feeble bill. If all goes well with it that tiny eaglet, by the time these notes appear in print, should be a strong, fierce eagle, and in mid-July it should leave the eyrie for the limitless aerial plains of which the golden eagle is feathered monarch.

Seton Gordon

GOLDEN EAGLET IN ITS NEST

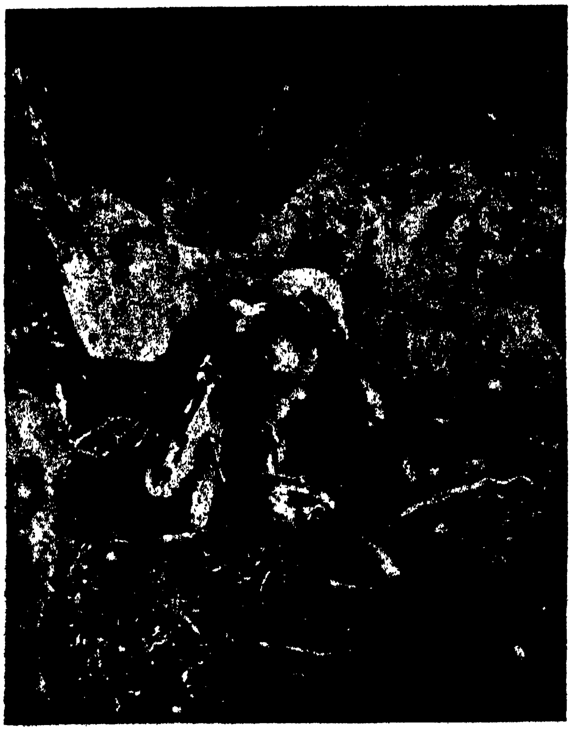
Here in surroundings typical of the wild country which is the golden eagle's last sanctuary in Britain, we see an eyrie or eagle's nest with a downy young bird crouched among the heather roots which line its home of twigs and pine branches.

Of all British birds the golden eagle is easily the most picturesque and magnificent, and is now found only in the wildest districts of the Scottish Highlands.

Much of late has been written on the present-day position of the golden eagle in the Highlands and some writers have expressed the opinion that this fine bird will soon become extinct. There is no doubt that many golden eagles are shot and trapped annually, but I do not think the species is in any danger so long as there exist large deer forests in the Highlands. In a deer forest the eagle is looked upon with friendliness. It keeps the grouse down, and grouse in a deer forest are almost as unpopular as eagles on a grouse moor, for the most careful stalk is often spoiled by an old cock grouse rising at the critical moment and by his lusty crowing giving the alarm to the deer.

But no bird can be considered secure. Take the sea eagle. About the year 1860 this bird was numerous along the sea coast of western Scotland. There is now not one sea eagle left. The bird's fondness for lambs brought about its wholesale destruction, for it was shot and poisoned ruthlessly, and is now but a name. Sea eagles were sometimes tamed as pets. MacLeod of MacLeod tells me that a sea eagle was formerly kept as a pet at Dunvegan Castle in the Isle of Skye. It was allowed its freedom,

Seton Gordon



Seton Gordon

EYRIE, EGGS, EAGLET AND PREY

In the lower photograph of an eyrie we see two of the kills made by the male for its young, a hare and a grouse. The grouse is just in front of the eaglet's legs and the hare is in the right foreground Above we have a nest on the Atlantic coast.

yet was so tame that it would appear in the blue vault of heaven and plane earthward at great speed if MacLeod stood outside the castle displaying a rabbit for its dinner.

The chief of MacLeod told me an amusing story about this bird. An old woman one evening was fishing in the sea for saithe, beneath the castle. As she caught the fish she threw them, one after another over her shoulder on to the grass behind her. At length, when she considered that she had caught a sufficient number, she ceased her fishing and turned about, meaning to gather up her catch. Imagine her feelings when she saw the old sea eagle, looking towards her expectantly as it stood on the grass, while not one single fish remained. The eagle had swallowed the saithe one by one as the old wife had thrown them considerately to it, as the bird doubtless thought.

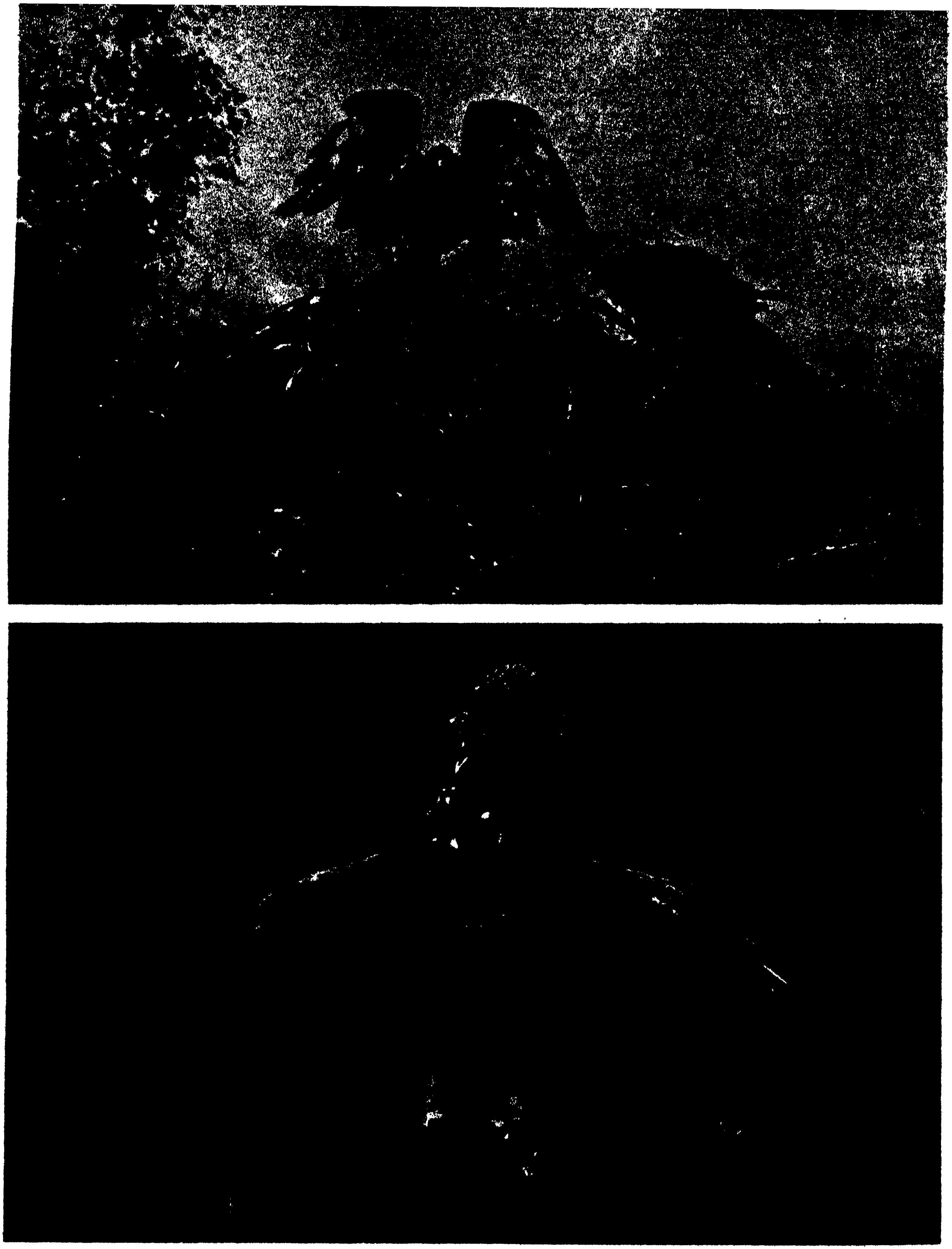
The nesting season of the golden eagle takes up half of the year. Towards the end of January, if the weather be open, the eagles begin to repair their eyrie, and it is a fine sight to watch an eagle struggling against a winter gale while she carries in her bill a large branch. Eagles are particularly fond of pine branches for the construction of the eyrie, and they will fly considerable distances to the nearest pine tree. Some of the branches taken are as thick as a man's wrist. Nest-building goes on during February, and the eyrie is completed by mid-March, if the site be in any sense of the word a sheltered one. From the fifteenth to the twentieth of March the

E.N.

E.N.A.

EAGLE DEVOURING ITS PREY AND A FINE SPECIMEN TRAINED FOR "HAWKING"

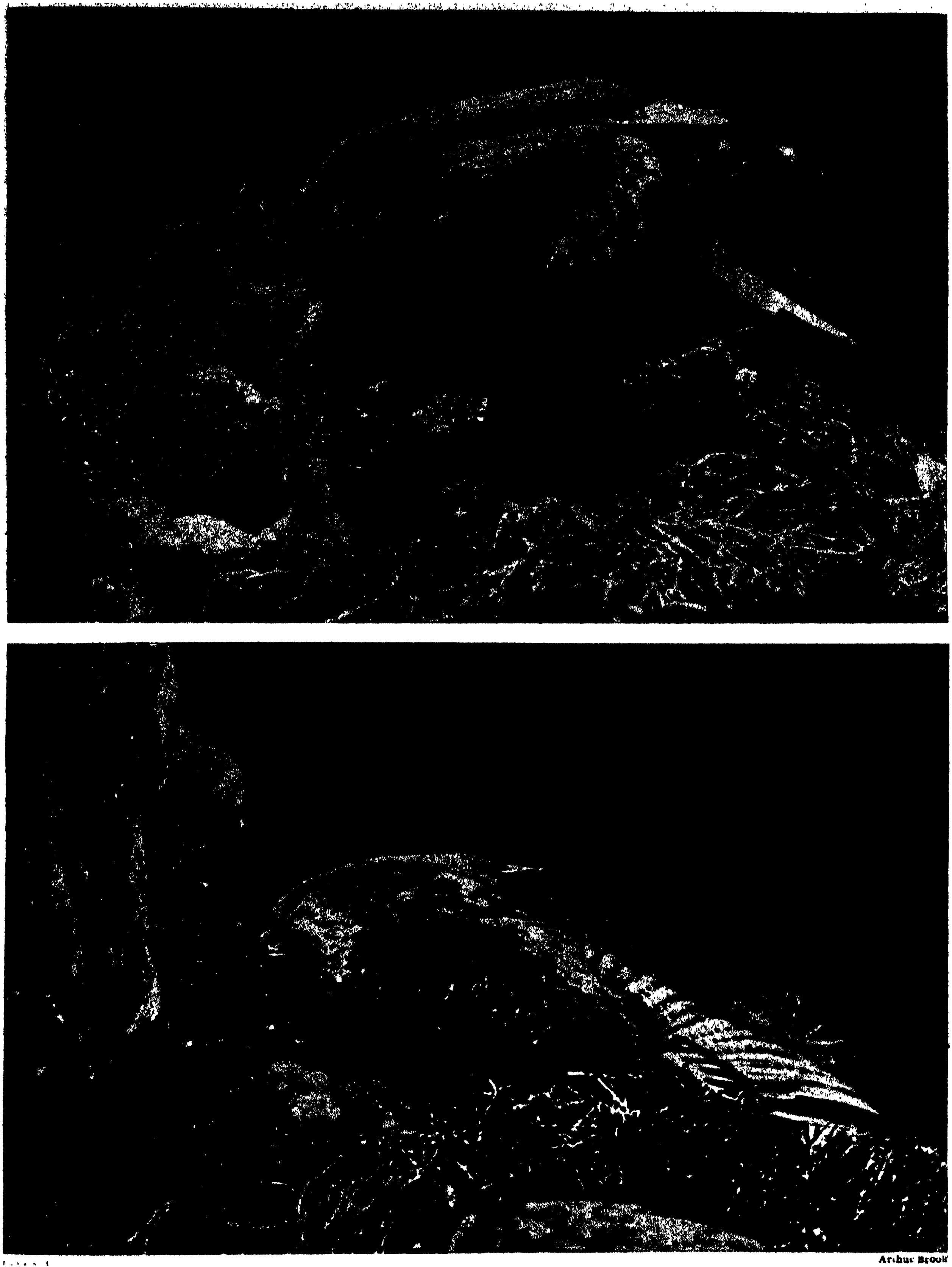
Some people still carry on the ancient practice of hawking with all its fine art of training wild fierce birds to obey the will of the falconer. But to train hawks is one thing and to hawk with eagles quite another. Yet human ambition has achieved even this. In the upper photograph is an eagle on the heavily gloved fist of a daring falconer. The great bird is about to be flown at a quarry. The lower photograph shows the head of an eagle as it hungrily eats the prey which it has caught.



Capt. C. W. R. Knight

HOW THE GOLDEN EAGLE LOOKS WHEN IT IS IN A REALLY ANGRY MOOD

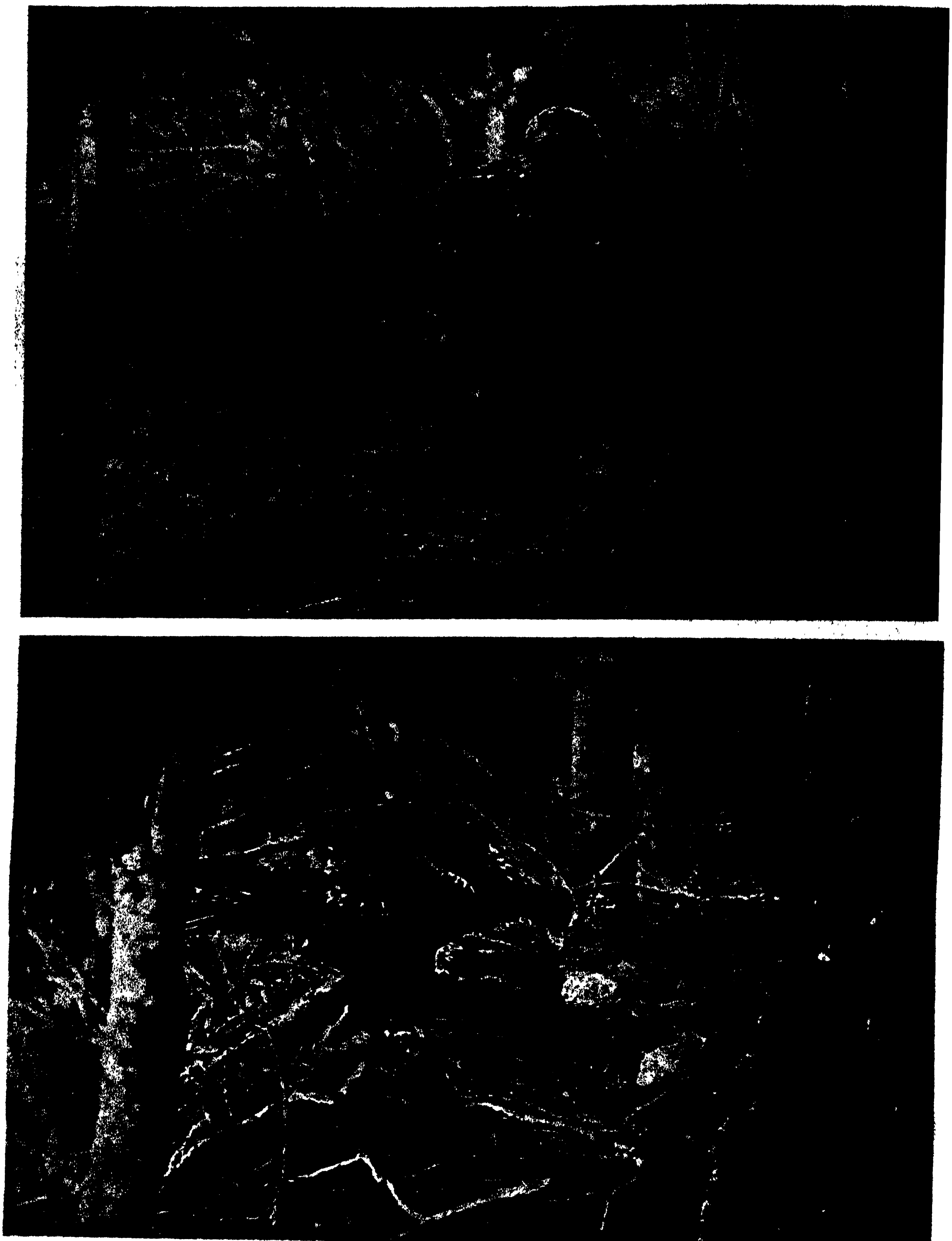
With a dead rabbit in its great curved talons the golden eagle prepares to enjoy the quarry it has caught (bottom). This is the same bird as appears in the upper photograph in page 1137, and it has one of several rabbits which it caught in a day's hawking in Kent. Notice the angry attitude of the wings and ruffled crest feathers. Above is a photograph of an eyrie with two birds in a quarrel. When really annoyed the golden eagle gives a very fine exhibition of temper.



Arthur Brook

MATERNAL CARE: SHELTERING THE YOUNG FROM THE RAIN AND FEEDING THEM

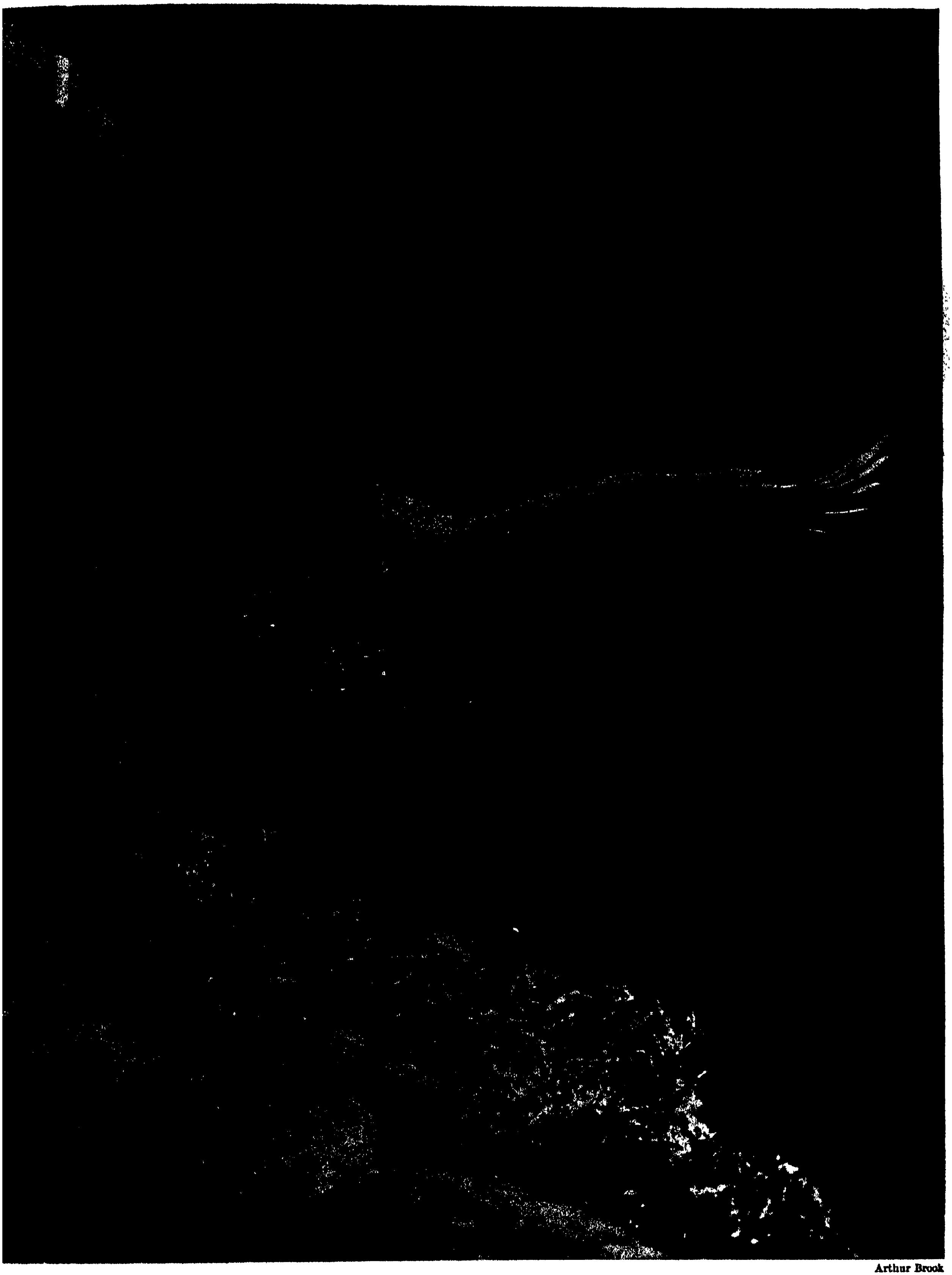
When bad weather comes—and on the west coast of Scotland the rainfall is very heavy—the eaglets must be protected from damp and cold. The mother bird, therefore, covers her little ones with a wing. In the lower photograph we see an example of this maternal care, the eagle standing with its head to the crag against which the eyrie is built, to lessen the discomfort of the driving rain. Above is a family being given its dinner which a hard-working and swift-winged parent has been procuring for it.



Seton Gordon

EAGLE CONVICTED OF LAMB STEALING: A TREE EYRIE OF THE HIGHLANDS

For the most part the golden eagle feeds on mountain hares and, failing hares, grouse. It is only where both these are scarce that the bird will carry off lambs. Many golden eagles pass their whole lives without lamb-stealing, a habit only occasionally formed, but which has got the whole family a bad and largely undeserved name. In this page is a very remarkable photograph of one of these culprits caught in the act. The lamb has been carried up to the nest and is being torn in pieces for the young. Above is an eyrie in a tree.



Arthur Brook

EAGLE AND THE GROUSE FOR WHOSE DESTRUCTION IT IS BOTH PERSECUTED AND PRESERVED

Many people have lamented the probable extinction of this the largest and noblest of British birds. But while gamekeepers on the grouse moors do undoubtedly shoot and trap and poison these great birds of prey on account of the damage they do to grouse, which are preserved for men to kill, in the deer forests the golden eagle is not molested as a rule. This is just because it helps to keep down the grouse which often betray the stalker to the deer by getting up in alarm and noisily proclaiming danger. Here is an eagle with a fresh killed grouse.

Seton Gordon

Seton Gordon

EAGLET GROWS UP AND MAKES A START IN LIFE

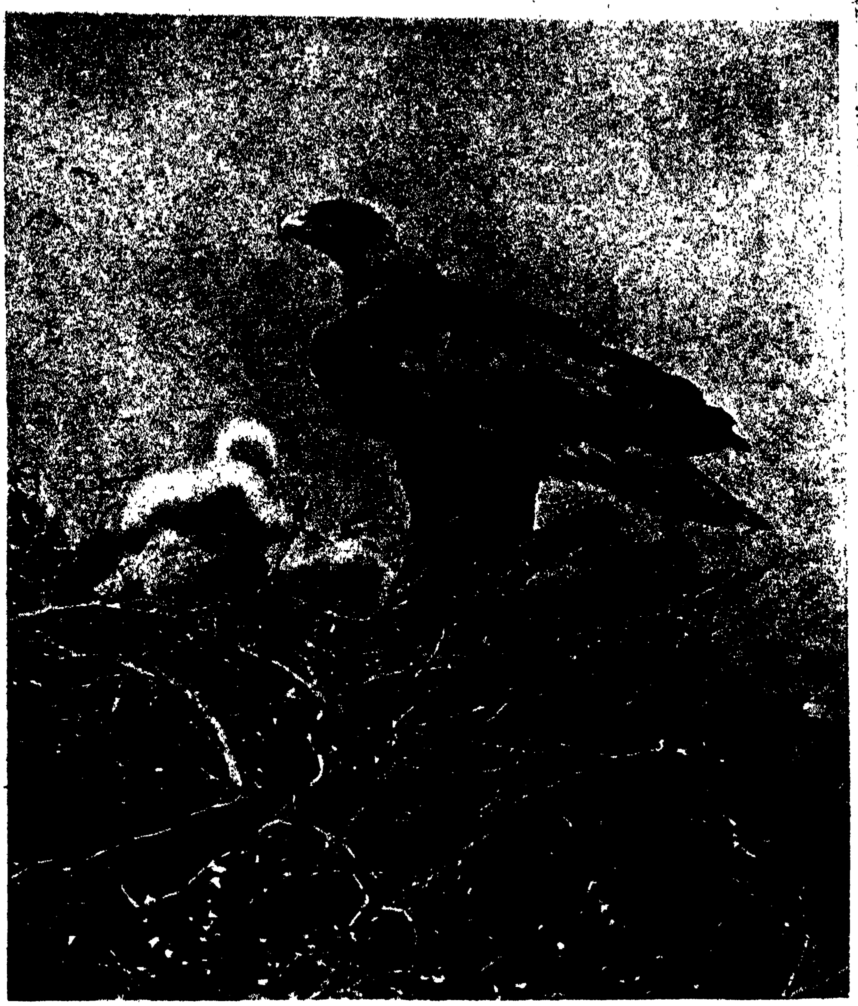
About eleven weeks after hatching the eaglets leave the nest for their first flight. The lower photograph shows an eaglet that has safely reached the ground after the first adventure into space. It has now to start life on its own, after weeks of care and protection. The upper photograph shows the bird a week or so earlier in its career.

two eggs are laid. They are somewhat rounded in form, and are usually covered with a profusion of rich brown spots and blotches. The earliest hatching date for the eaglets that I have known is April 29th. Usually they first see the light during the opening days of May. When they are hatched they are clad in white down, and after a time this baby coat is replaced by a second downy coat. At the age of a month the eaglets commence to show their feathers, and the young quills grow rapidly. The eaglets fly from the eyrie eleven weeks after they have left the egg.

A few years ago my wife and I spent thirty-one days in a hiding tent set up some thirty yards from a golden eagle's eyrie built in an old pine tree, and during that time, taking watch and watch about, learned many interesting things about the home life of the golden eagle. At first the birds were full of suspicions of the hide, carefully camouflaged though it was, and we spent more than one fruitless watch without seeing anything of the eagles. But after a time they became more or less used to us, and a fact in our favour was that the nest was in a moderately thick wood, so that the eagles could not keep so careful a watch on us as they would have done had the nest been built upon an open rock. The female eaglet—always the larger of the two hatched—was in this instance of an unusually bullying disposition, and led her wretched brother a fearful life, tormenting him day after day. She used to chase him round the nest and aim blow upon blow at him, so that every day we feared lest she should kill him.

It was only his greater agility (he was half-starved, as his sister took his share of the food) that saved him, for he was often able to elude her onslaughts by sprinting round and round the eyrie while she followed in pursuit. But when the eaglets had reached the age of a month they lived quite amicably together.

This pair of golden eagles fed their young sometimes on squirrels, and we often wondered how they were able to capture these nimble animals. The eaglets were always disappointed when they saw father arrive with a squirrel. They hated the long dry fur of a squirrel, and they were not able to skin the animal. And so they swallowed fur and flesh together, making exceedingly comical, wry faces as they did so.



Seton Gordon

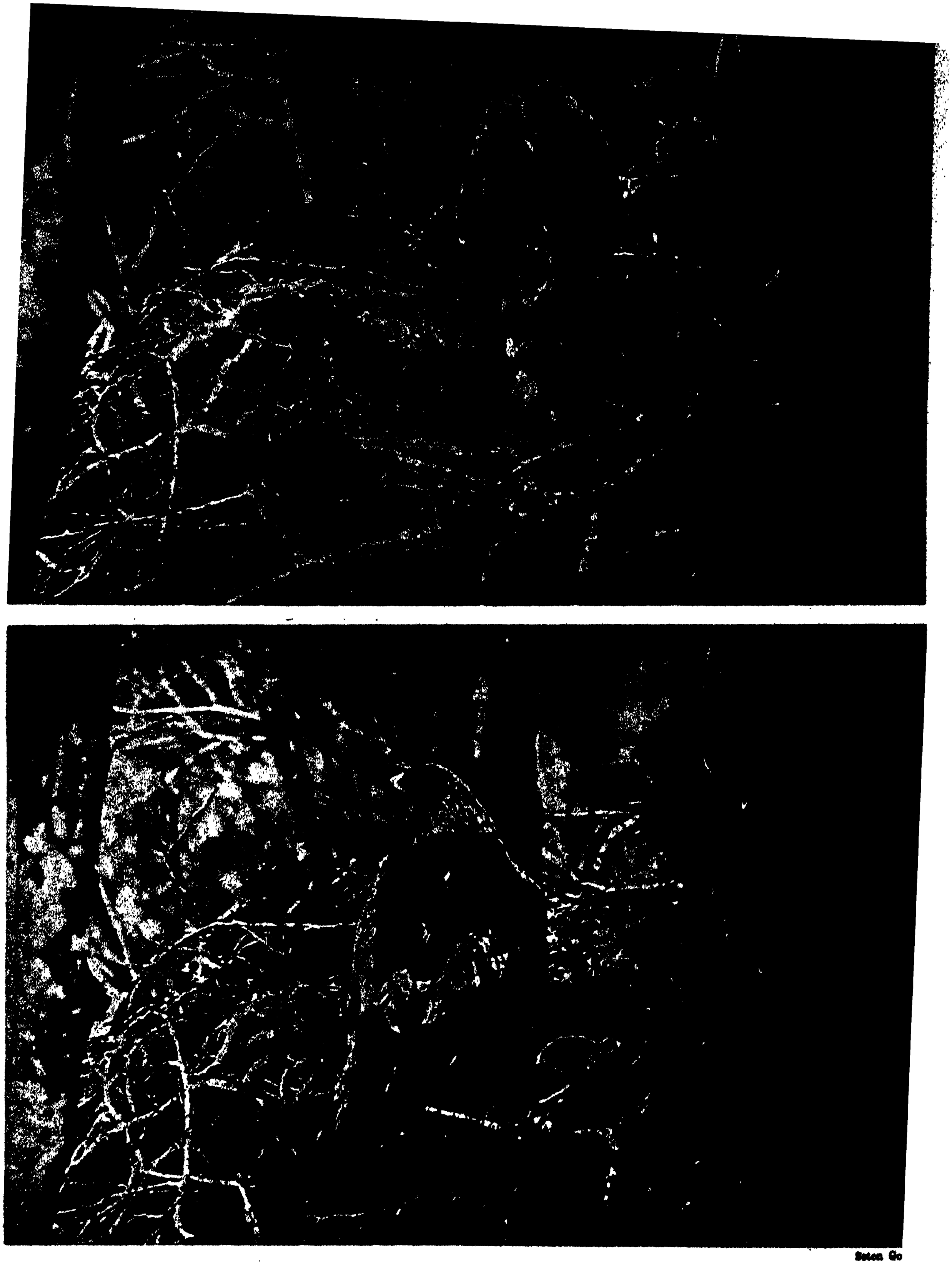
GOLDEN EAGLE WHOSE COLOUR IS WHITE OR BROWN ACCORDING TO AGE

One of the first things to realize about the golden eagle is that it is not golden. The general colour is dark brown, the tail being marked with dark grey. Only on the neck is there anything approaching a gold tint in the plumage. The young when first hatched are clad in white down. This first coat is moulted for a second, and at about four weeks old the feathers begin to show.

The mother of this pair of eaglets hardly ever brought prey herself to the eyrie. The cock did the hunting, and the female used to watch his arrival from some viewpoint near, and within a few seconds of his taking wing (he usually remained only a few seconds at the eyrie) she sailed down to the nest and commenced to tear up the prey he had brought and feed the eaglets on it. It was noticeable that she never fed the small male eaglet until his large and bullying sister had been satisfied.

No lamb was ever brought to this eyrie, but a golden eagle of the west of Scotland, which we photographed at home, brought several lambs to her young. And this brings me to the interesting and much-debated question : Is the golden eagle destructive to lambs ? To this question I would answer, " Yes and No." Let me explain. Under ordinary conditions golden eagles do not prey on lambs. On a moor or forest where the mountain hare is plentiful, eagles prey on the hares. As a matter of fact, they prey habitually on grouse and ptarmigan and rabbits, if these are present, and in a country where any of these species—hares, rabbits, grouse, or ptarmigan—are found in any numbers, lambs are as safe as if they were in Hyde Park. But in the north-western Highlands there are stretches of wild country where not a living thing except a sheep may be seen during a day's walk. Here the golden eagle does at times prey upon lambs—for the sound reason that it has nothing else to prey upon.

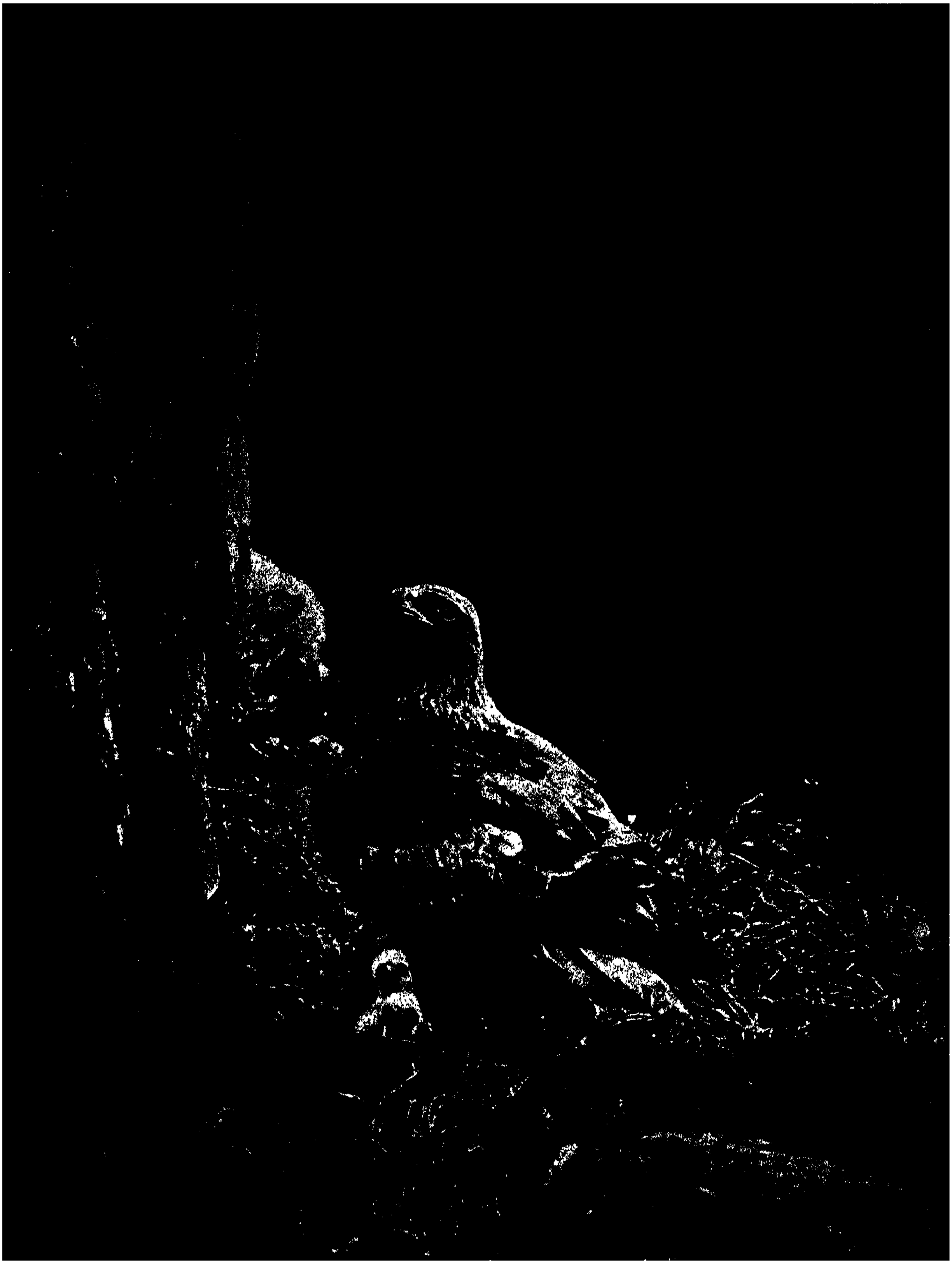
I live in a golden eagle country, and I do not think that any of the golden eagles of my acquaintance—and at least half a dozen pairs nest within easy motoring reach of my home—have ever taken a lamb. Perhaps a lamb-eating eagle might be placed in the same category as a man-eating lion.



Seton Go

BACK AND FRONT VIEWS OF A GOLDEN EAGLE AS IT FEEDS ITS EAGLETS

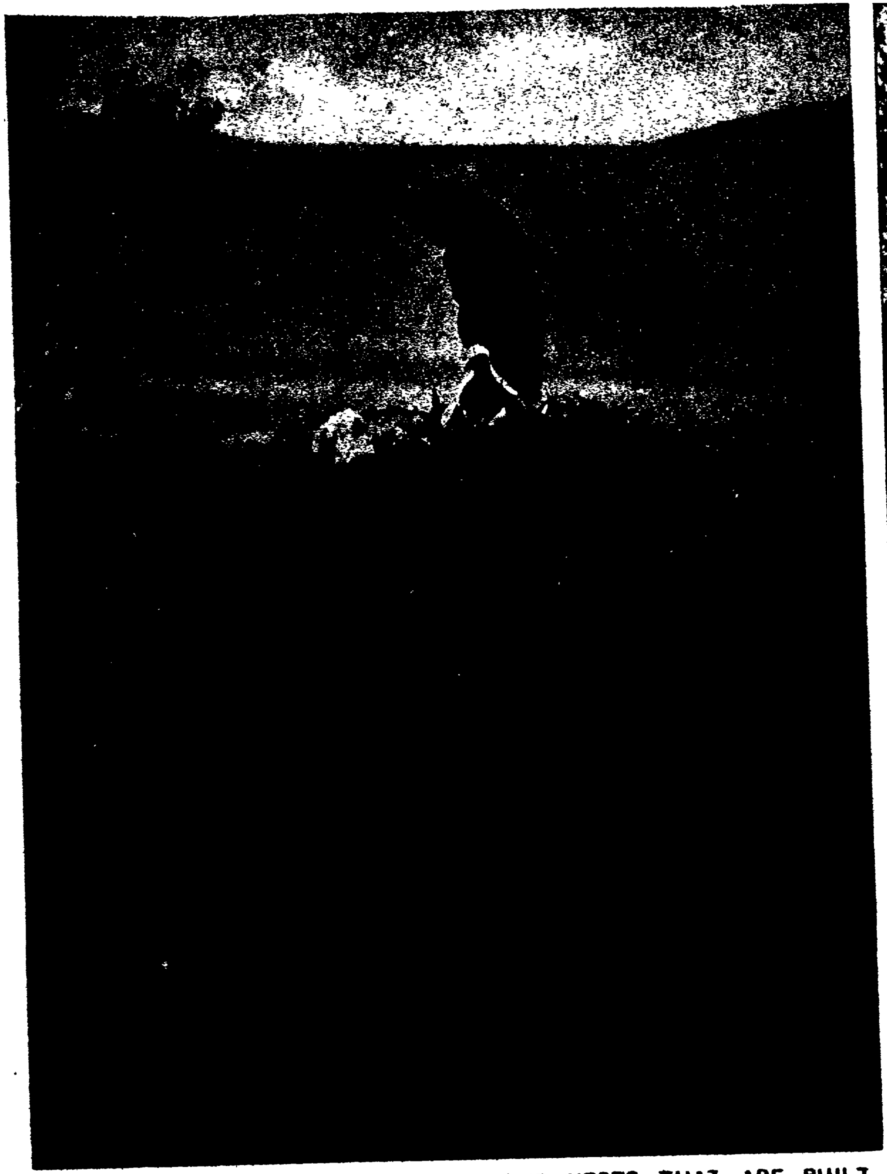
To obtain such photographs as these, or to make intimate observations of this very shy and formidable bird, such as are recorded in chapter means not hours, but days of watching and waiting, and the spirit which can cope with disappointment. A "hide" is constru sufficiently near the nest for a good view and yet not so near as seriously to alarm the eagles. In only the wildest parts of Scotland is golden eagle now found, although until about the 'sixties it was known in the Lowlands and a century before that in the Lake Dist

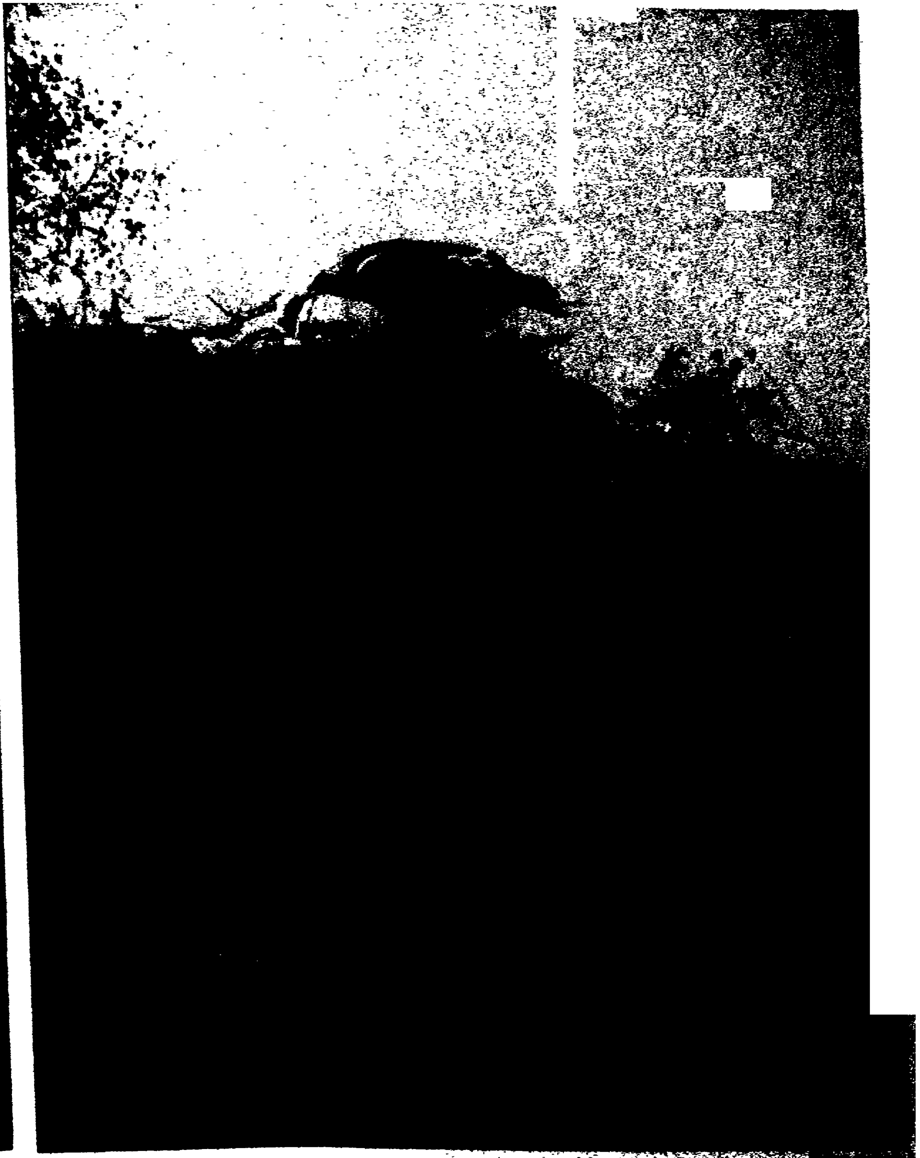


Arthur Brock

EYRIE AND ITS TENANTS ON A HIGH CRAG IN A SCOTTISH DEER FOREST

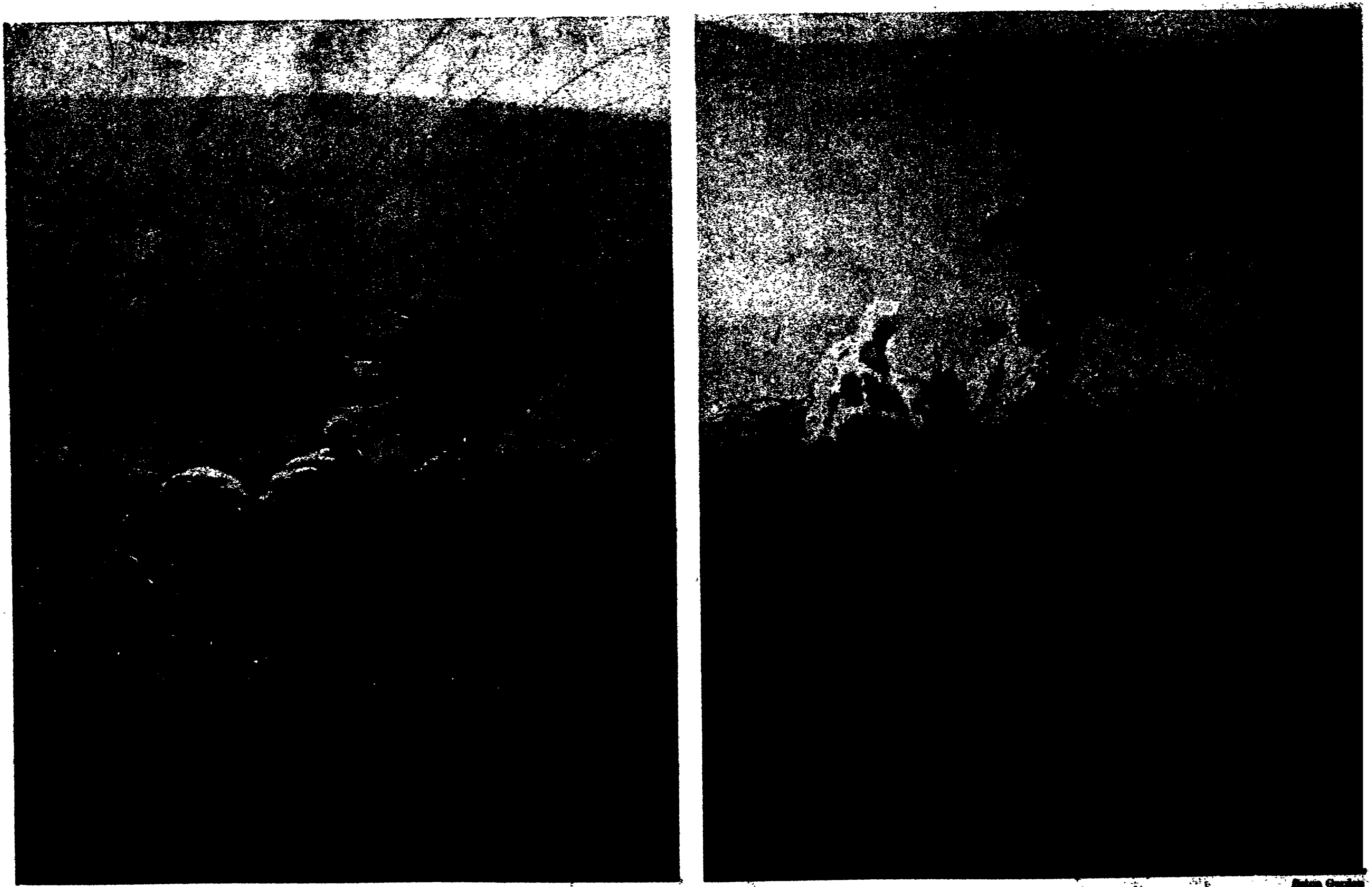
With the golden eagle the female is larger than the male and seems to require more food in infancy. At least, it has been observed that, of two eaglets in a nest, the female ate her own share and most of her brother's and only the effects of gluttony kept her from inflicting severe damage on her more hungry but more agile brother. The male bird does most of the hunting, the female receiving the prey—grouse, hare or perhaps squirrel—and tearing it to pieces for her ravenous and rapidly growing progeny.





LONELY TREE NESTS THAT ARE BUILT AND REPAIRED FROM JANUARY TO MARCH

Eyries are usually built on inaccessible crags, and, very occasionally, on the ground. Sometimes a tree is used, as we see in the above photographs. Sticks and twigs are [illegible] about the end of January, quite large branches, as thick as a man's wrist, being picked up and carried to the selected site. A grand spectacle it is to see one of these fine birds [illegible] a winter gale and coping, at the same time, with a large branch. Pine branches and twigs are especially favoured, and the birds make long journeys, sometimes, for the sake of [illegible] the wood they want. The closely made framework is lined with heather and tufts of grass.



Seton Gordon

MAJESTIC HUNTERS OF THE WILD SCOTTISH HIGHLANDS PHOTOGRAPHED AT HOME

Fond of soaring and circling at a great height with its wings and tail outspread to the utmost, the golden eagle has also been seen to hunt low down near the ground. It pounces upon its prey, but does not, as a rule, chase it. The young deer are occasionally carried off, and the bird is not at all above eating carrion upon occasion. Traps can accordingly be set for it, and considerable numbers of golden eagles have been killed in this way because they were considered a menace either to sheep or to grouse. The female, when full grown, is three feet long and the male about three inches less. In Scotland the bird is often more appropriately called the black eagle.

Seton Gordon

EAGLE PROTECTS ITS FLEDGLING FROM SLEET

Eaglets are born when winter weather may be still about and the mother must lend the shelter of her wing if the eaglet is to survive. This photograph gives us an excellent idea of the remote and inaccessible sort of place that an eagle usually chooses for its nesting site—a ledge in the face of a precipice on a lofty Highland mountain

It may be of interest to mention here the life observations of a sheep farmer of western Inverness-shire. He is a skilled, and exceptionally observant naturalist, and he has never once during his long life either seen a golden eagle attack a lamb or seen a lamb in a golden eagle's eyrie.

Much has been written of the speed of a bird's flight, and it is usually believed that the peregrine falcon is the swiftest flier. My own opinion is that the golden eagle upon occasion is faster. I will narrate an experience I once had. I was watching from a hide an eyrie of a pair of eagles. The afternoon was hot and sultry, and I put my head out at the back of the hide to get a breath of fresh air. I happened to notice what, for a moment, I thought was an insect against the blue of the sky. Then, to my astonishment, I saw that it was one of the eagles. It was the male, and he was travelling like a thunderbolt, rushing down from the high ground with a ptarmigan held in one foot. For an eagle to be mistaken for an insect he must be at least a mile off and that mile was covered in well under half a minute. It was the most spectacular flying I have seen.

There is nothing sadder to see than a golden eagle caught in a trap. Not long ago I happened to be passing a wild corrie where a pair of eagles have nested from time immemorial. The eyrie was unoccupied, and I was wondering where the birds were nesting, when I saw, placed on their favourite resting knoll, a large steel trap. The trap had been sprung, and there was nothing in it, so I imagined that the eagle had escaped. But the friend who accompanied me for some reason looked over the cliff (he told me afterwards that he had felt an impulse to do so), and saw there a magnificent male golden eagle hanging with outspread wings at the end of a steel chain, its leg held in a trap.

With little difficulty we hauled the bird up. He had been some days a prisoner, and all hope of escape had evidently gone from him, for when we pulled him up he lay exhausted at our feet. The snap of the jaws of the trap had broken the bone of his leg; all that held the leg to the foot was a few tendons. These we cut through, and, carrying the eagle to a safe place away from the rocks, laid him upon the short heather. For a few seconds the great bird remained motionless. We began to think he was incapable of flight, when suddenly he seemed to realize that he was free, and stumblingly half-flew, half-hopped across the hill. He was heading straight for the precipice, and my friend, thinking that he would be dashed to death on the rocks, made as if to follow him. But he had scarce moved when a wonderful thing happened. The eagle felt the uprushing current of air at the edge of the cliff. Wide he opened his great wings, and mounted vertically into the sky at incredible speed. After sailing awhile serenely, he came to rest on a snow field farther up the corrie.

I will end this article with a plea for the golden eagle. I would urge that leniency should be shown towards it, for it is without doubt the finest of all British birds, and should it share the fate of the sea eagle, the loss to a nation of bird lovers would be great indeed.

Chapter CII

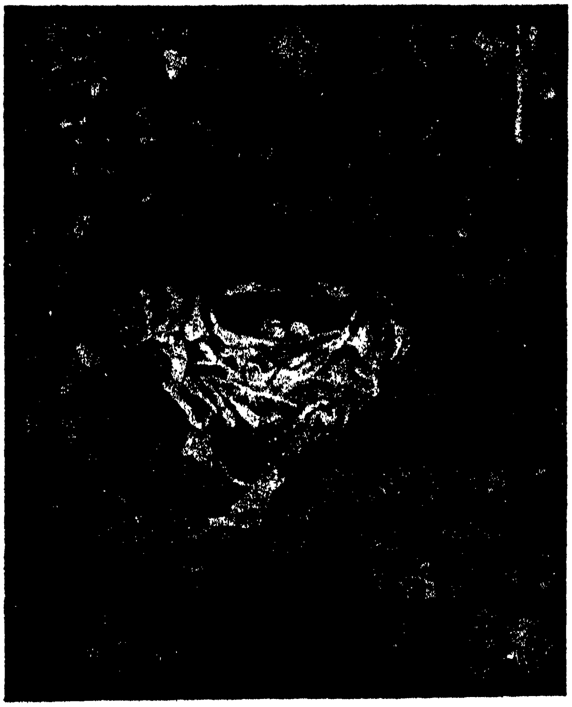
Changes of Habit Among Living Animals

By Prof. J. Arthur Thomson

Regius Professor of Natural History, Aberdeen University; Author of "The Study of Animal Life"

One of the characteristics of life is plasticity, but it is not always in the same way that living creatures become suited to new circumstances. Sometimes an intelligent change of habit is effected very rapidly. Thus it is only about a century since sheep were established in New Zealand, but the naturally vegetarian or frugivorous kea parrots (*Nestor notabilis*) have learned in that time how to tear away the fleece from the loins and get at the fat and flesh above the kidneys. They usually attack sickly or fallen sheep, but they sometimes kill normal animals; and in either case the new habit is a very remarkable one. The bird may have begun by pecking at the fat adhering to skins pinned out to dry. Many discoveries among animals, as in mankind, are made half fortuitously, and intelligence is shown in the way the discovery is appreciated and utilised. Big-brained birds like parrots are not slow to take a hint, and the new device would probably spread by imitation.

The herring gull and the lesser blackbacked gull are characteristically fish-eaters, but it has been known for a long time that they are not averse to eating corn in the harvest fields. This tendency to vegetarianism has become increasingly marked in Scotland during the twentieth century. Two or three hundred gulls may be seen busy among the stooks on a single field of corn, and they also gouge out the insides of turnips in a systematically disastrous way. They will also dig up potatoes near the surface. The chief reason for this inland vegetarian feeding is probably that the numbers of herring gulls and lesser blackbacks have greatly increased, partly through protection, and partly because the birds of prey that used to devour the young gulls have become scarce. The white-tailed sea-eagle is no longer to be found in Scotland; the raven has practically gone; and the peregrine falcon is rare. It is probable that the increase of trawling has restricted the readily available fish-supply for herring gulls and lesser blackbacks; and this would naturally suggest to shrewd birds the exploration and exploitation of other fields. So there has been, to man's loss, an intelligent and rapid change of habit. It may be noted in passing that the multitudes of small black-headed gulls often seen in the fields are mainly to the good, since they are predominantly insectivorous, and destroy huge numbers of injurious pests.



ROBIN THAT BUILT A PAPER NEST

Robins, favoured by man as few birds have ever been, have learned to profit by picking up his unconsidered trifles. In this case a robin found a heap of paper in a farmyard and made a nest entirely of paper save for the horsehair lining.

It is easy to put a date-limit to the kea parrot's change, namely, the introduction of sheep into New Zealand. There are also many observations to show that the herring gull and the lesser blackback have changed their diet in increasing numbers of recent years. But there are other cases of similar changes which must have taken a much longer time. The robber-crab (*Birgus latro*), common on Christmas Island and the like, is a giant relative of the hermit-crabs in shore waters. But it has become terrestrial and does not require to go to the sea except to spawn. This change of habit from water to land must have required a very long time, for it is associated with a change in the breathing organs—a change which could not be effected quickly. The robber-crab has to breathe atmospheric air, not the air mixed in the water as ordinary hermits do. But what we are concerned with at present is something different, namely, the robber-crab's novel habit of climbing the stems of the coco-palms in order to secure the nuts. With its heavy claw the crustacean makes a hole in the nut and spoons up the flesh. The broken shell may be afterwards used, in hermit-crab fashion, as a shelter for the tail.

Now, this extraordinary habit of climbing the coco-palm could not, we think, be learned in a day, and yet it must have been learned, and not so very long ago, for the coco-palm is not a native of these parts. The coco-palms of Christmas Island must have sprung from nuts wafted by currents from distant shores. Let us be clear at this point that hermit-crabs have an instinct—an inborn, hereditary, racial predisposition or prompting—to shelter their vulnerable sensitive tails in some borrowed house, usually the shell of a whelk or some other sea-snail. The robber-crab's tail is not soft as in hermits, yet *Birgus* is true to the ancestral instinct to seek some extrinsic shelter, such as the personally secured shell of a coconut, or the fortuitously discovered empty beef-tin. This is an instinctive prompting, but the climbing of the coco-palm is surely an intelligent response to a new situation. We take it as an instance of a new habit adopted intelligently but probably requiring generations of testing before it became part of the orthodox routine of life. Organic evolution is a long-drawn-out commentary on the text: Test all things and hold fast that which is good.

The case of the robber-crab and the coco-palm seems to us to illustrate well, what is so often ignored in conventional biology, that all robust, resolute animals share in their own evolution. They are not inert items that are being sifted against an inexorable sieve; they are rather individualities which struggle and strive. They are not mere pawns, moved by a callous environment; they are living creatures that insist on sharing in the game. No doubt each receives by heredity its particular hand of cards beyond which it cannot go; but it is more or less open to each organism to play the hand for all it is worth.

Inborn in many animals are certain reactions which always occur in answer to a particular stimulus. When the earth vibrates the worm jerks itself back into its hole; and when the action is as simple as this it is called a reflex. The brain is not needed and the action is involuntary. A message from the outside world is received by superficial sensory nerve-cells (S); the thrill passes to associative nerve-cells (A) in the nerve-cord; it is shunted to motor nerve-cells (M), also in the nerve-cord, which command the effector (E) muscle-cells to contract. We may compare the sensory nerve-cells to scouts; the associative nerve-cells to general headquarters; the motor nerve-cells to the executive officers; and the muscle-cells, or "effectors" (E) to the 'men' that do the work. Taking the first letters of the words, we may indicate a simple reflex action by the letters S A M E (sensory, associative, motor, effector); and as it often happens that one reflex action sets another at work, as sucking is followed by swallowing, this might be conveniently indicated by S A M E, followed by S A M E, followed by *S A M E*.

Such chains of reflex actions form instinctive behaviour, considered from the physiological side; but many instincts have probably more or less of a psychological aspect as well, being suffused with awareness and backed by endeavour. A hive-bee forces its way into a difficult flower, it collects the pollen, it stows it away in its pollen-baskets, and when these are full it makes a bee-line for home. It does not need to learn to do these things the capacity for doing them is part of its hereditary make-up. An instinct is an inborn, ready-made power of doing apparently clever things.

Now the meaning of this digression is to suggest that in new surroundings or circumstances animals have very little power of changing their instincts; what they may be able to change are their intelligent habits or their individually learned associations. This difference makes the whole problem of change or no change more intelligible. When a young partridge or redshank hears its parent's danger signal it is bound to squat and remain motionless. This is instinctive behaviour. But when a mother otter is teaching her cubs how to behave when the hound's bark is heard, she is establishing an association; and when she is teaching them how to catch trout or how to eat frogs, she is appealing to their intelligence. The habits built up on the basis of association or of intelligence are more or less changeable if the conditions of life change. In short, the more instinctive an animal is, the less plastic it is; and the more intelligent an animal is, the more educable it is. When the schoolboys in Italy adjust a moving Indian file of processionary caterpillars so that the head of A is brought round to touch the tail of Z, the larvae may go on circling for hours, obeying their instinct, unable to break the spell. But everyone knows that intelligent mammals can be trained to do all sorts of unusual things, and to adjust their behaviour to altered circumstances.

The word "modification" is applied by naturalists to individual changes of structure and function that are directly due to some change or peculiarity in surroundings, food or habits, and that persist after the inducing cause has ceased to operate. If a man goes to the tropics for some months, he may become very brown and freckled. This means that an unusual amount of a dark pigment called melanin, familiar in Negroes, is deposited in the skin. There is an advantage in this, for it may save the skin from being burnt in the glare. This kind of change is very common, and it is called an adjustment, the point being that it does not last. After a few months at home the extra pigment has been absorbed, and the man is as he was. But if he stayed thirty years in the tropics, he might become so thoroughly tanned that he would remain brown after he returned to England for the rest of his life. This would be called a modification, or an individually acquired character. It persists after the inducing cause has ceased to operate, but there is very little evidence that it can be entailed on the offspring in any representative degree. This is a separate problem which cannot be briefly discussed; let us rather give some examples of modifications.

If sheep be taken to a much colder climate, they sometimes grow a thicker and longer fleece, a useful protective modification. In the next generation the wool is still longer and thicker, and this is natural enough, since the offspring are under the influence of the cold from birth onwards, whereas the parents

W. S. Berridge

F. W. Bond

KEA PARROT OF NEW ZEALAND THAT ALTERED ITS DIET FROM FRUIT TO FLESH

While habits may take thousands of years to change, they may also alter very quickly as has been the case with the kea parrot of New Zealand. This was an entirely vegetarian bird until sheep were introduced from Europe. It has since formed the habit of perching on the backs of sickly or fallen sheep and tearing away the fleece from the loins so as to get at the fat and flesh above the kidneys. This habit possibly began by a chance finding of a fleece with some meat adhering to it and imitation, so strong in parrots, may have helped to spread the habit.

experienced it only after their arrival. It has not been shown that there is any further increase after the first generation.

Similarly, if plants are transported from a low-lying region to the high Alps, they may develop a thicker skin or more hair on their leaves, a protective modification which their offspring may show even more markedly. If the plants are taken back again to the low grounds the individual leaves may retain the characters they acquired on the mountains, but the new leaves and the leaves of the offspring may be entirely of the low ground type. The Alpine modification does not last, and the same is true of the changes that follow exposure to desert conditions or the like. Some cases are intermediate between " adjustments " and " modifications."

THE experimental evidence of plasticity or modifiability is often very striking. In the caves of Carinthia and Dalmatia there lives a wan, blind newt called proteus, mentioned in another chapter. It is about six inches long, and shows no colour except where the red blood shines through the three pairs of external gills. The eyes remain arrested in development and do not reach the surface. But if proteus is brought from the cave to the new environment of a well-lighted laboratory it begins to develop spots, and in a week or two it is dark-coloured, like a common newt. And if a larval proteus is reared under red light its eyes grow larger, reach the skin, and become seeing eyes. The reason for red light is that white light would evoke a dark skin, thus shutting out the light from the re-awakened eye.

An experiment in the opposite direction illustrates what may be called a minus modification. A goldfish was kept for three years in complete darkness, care being taken to secure abundant food and freshness. The result was complete blindness, which was indicated in the structure of the eye by the degeneration of the rods and cones, the percipient elements of the retina. This proved that the normal stimulus of the light is required in this animal to keep the structure of the eye up to the mark. The experiment would have had even greater interest if it had led to some knowledge of the state of the eyes in the blind goldfish's offspring; but there are not as yet any data on this subject.

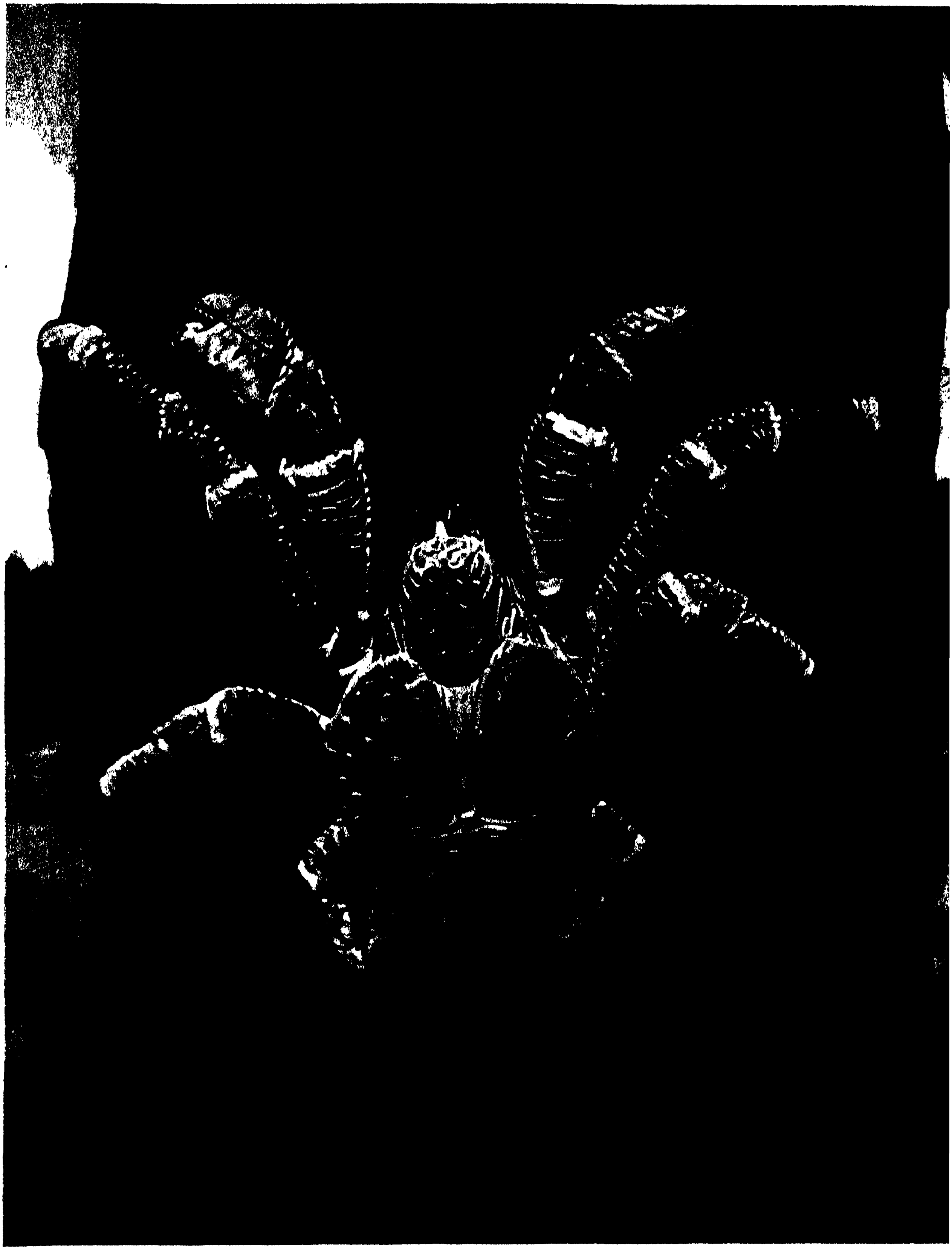
MANY of the animals, for example, fishes, crustaceans and insects, that live permanently in caves are more or less blind. They find their way about by their other senses, especially touch and smell. There are many different gradations in the state of the eye in different cave-inhabiting types, but some species are entirely blind. To some naturalists it seems justifiable to say that the blindness illustrates the hereditary accumulation of the results of disuse and darkness, but it is necessary to proceed cautiously. As we have already explained, part of the blindness of proteus is the outcome of an influence operating on each successive crop of individuals, for under the red light in the laboratory the usually arrested eyes may become seeing eyes. Therefore the sense of sight is not actually lost to the proteus race. Perhaps the same is true of other blind cave-animals. They are certainly walkers in darkness, but it is possible that they may recover their sight. No one knows, for no one has tried with sufficient care or for long enough, what may follow restoration to the light.

But there is another way of looking at the facts. Eyes are very variable structures; that is to say, they may be better or worse from birth onwards, apart from the direct influence of illumination or of darkness. A variation is an inborn peculiarity whose origin is still obscure ; it is the outcome of some germinal change and is quite different from a bodily modification. It may be due to some disturbance or rearrangement, some strengthening or weakening, of the hereditary items or ' factors ' that make up the inheritance carried by the egg-cell and the sperm-cell. Albinism, or the absence of pigment, as in a white blackbird, may be mentioned as an example of minus variation ; the appearance of long Angora hair in various types of mammal, such as rabbits, is a plus variation. In regard to many new variations we know that they are readily entailed by heredity on the offspring ; and this is more than we can confidently say in regard to modifications.

NOW let us return to the cave. It may be that the frequent blindness of cave animals illustrates the hereditary accumulation of the results of disuse and darkness ; but there is little experimental evidence in support of this possibility. It requires fewer assumptions to suppose that variants, changing in the direction of poor sight a smany variants do, found their way into the grateful shade of the cave, and continued to vary in the same direction. The passage towards complete blindness would be assisted by Nature's way of sifting out all useless organs.

Darwin was much interested in the beetles of Madeira, because they illustrated so well his theory of Nature's sifting or natural selection. As is well known, his theory was that new departures or variations, which are always cropping up, are sifted in the struggle for existence. Any variation that gives its possessors some appreciable advantage will tend to secure their survival, while a variation that handicaps its possessors will tend to their elimination. Thus, the fitter, which simply means the better suited to particular conditions of life, will automatically tend to survive. The struggle for existence, which does the sifting, includes all the answers-back that living creatures make to environing difficulties and limitations ; it means much more than internecine competition among fellows; it may be a struggle against a changeful environment, or against foes of an entirely different type ; it may be other-regarding, as well as self-regarding.

As to the beetles in Madeira, the peculiarity is that so many different kinds are wingless. Out of the 580 species of beetles that were known in Madeira when Wollaston made his study, over 200 are so far



CRAB THAT HAS ADOPTED LAND HABITS AND CLIMBS TREES FOR FO

The robber crab of Christmas Island has entirely forsaken the sea, where its ancestors lived, save for spawning. Furthermore it has forme habit of climbing coconut palms for the sake of the nuts, whose kernels it eats and whose shells it uses as armour for its tail. This change happ at no very remote period, for coconut palms are not indigenous to the island.

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deficient in wings that they cannot fly. Moreover, of the twenty-nine genera peculiar to the island no fewer than twenty-three have all their species flightless. What is the meaning of this? It has no doubt something to do with the fact that Madeira is wind-swept, so that there is great risk of flying beetles being blown out to sea. But it is necessary to be more precise. The beetles did not intelligently shed their wings so as not to be blown away, for they are hatched out from the pupa-state without wings or with no more than vestiges of wings. It is an old-established constitutional peculiarity, we may be sure of that; and it is seen in many beetles which live in haunts where they are *not* exposed to any dangerous wind.

Another possibility is that the native beetles of Madeira learned to lie low, and in the course of generations lost their wings by disuse. But, as we have said, there is little evidence that the results of disuse can be hereditarily entailed. On the whole, the probability is that Nature's sifting favoured germinal variations in the direction of wing-reduction. To be quite fair, let us quote Darwin's careful sentences from "The Origin of Species" (1858). "Several conditions make me believe that the wingless condition of so many Madeira beetles is mainly due to the action of natural selection, combined probably with disuse. For during many successive generations each individual beetle which flew least, either from its wings having been ever so little less perfectly developed or from indolent habit, will have had the best chance of surviving from not being blown out to sea; and, on the other hand, those beetles which most readily took to flight would oftenest have been blown to sea, and thus destroyed."

E.N.A.

FATAL INABILITY TO CHANGE A HABIT

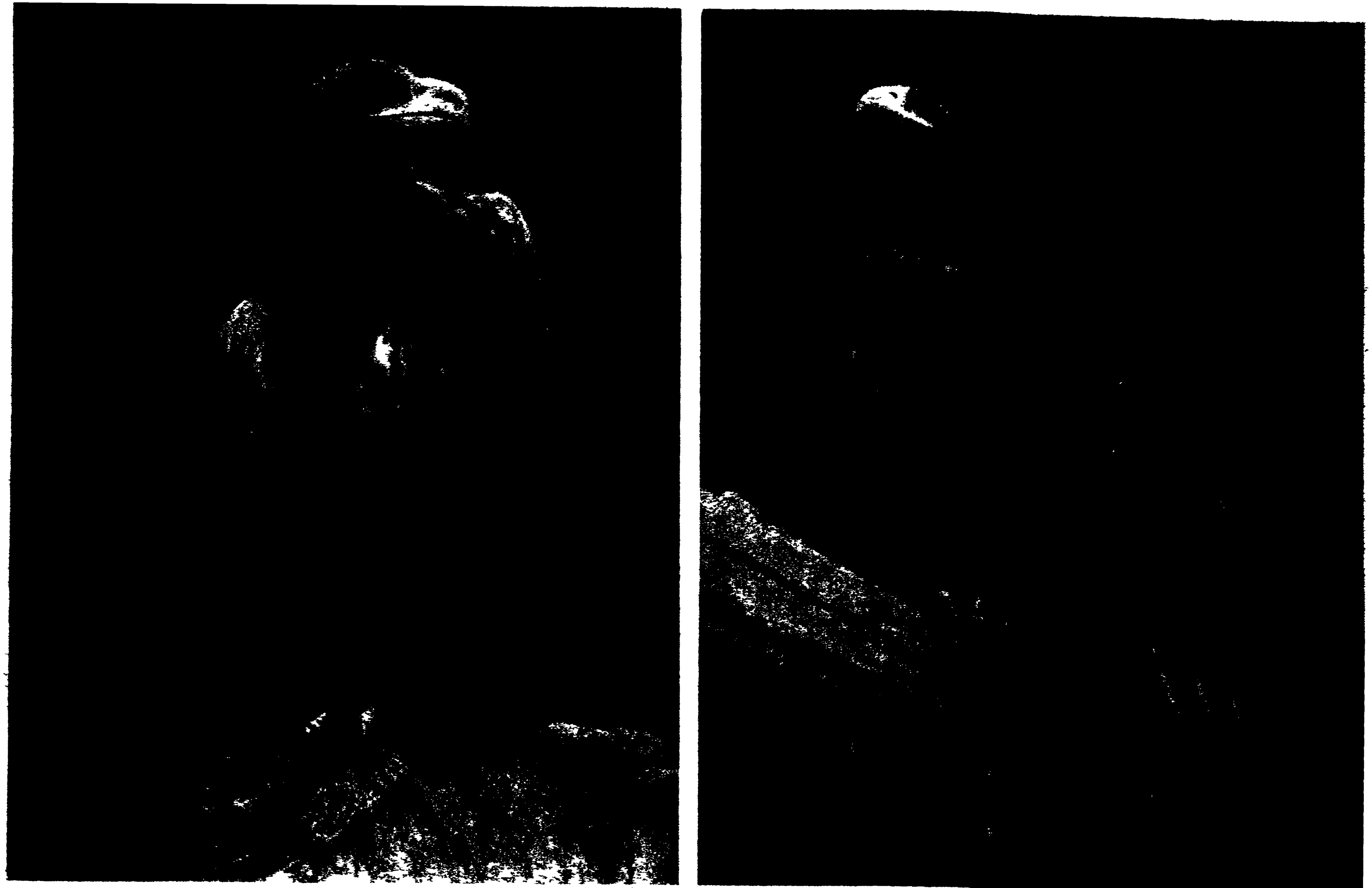
In the case of the processionary caterpillars seen above instinct is too strong for adaptation to suddenly altered circumstances. The instinct to follow the next caterpillar ahead is so powerful that if the individual at the head is joined to the one at the tail of the procession, the whole company will walk round in a circle for hours.

MAN has taken many plants and animals to new countries where they have done well, and this is best called naturalisation.

Acclimatisation, in the strict sense, means that the introduced plants and animals have become in the course of generations adaptively changed to withstand climatic influences which were at first unfavourable. This is generally believed in, but there is surprisingly little evidence of its actual occurrence. The whole question is very carefully considered in G. M. Thomson's "Naturalisation of Animals and Plants in New Zealand" (1922), and the conclusion is that there is actually very little to indicate acclimatisation in the strict sense, that is, fresh adaptation to new conditions of climate and surroundings.

When plants or animals get a footing in a new and different country, what happens? First there is often great increase in the number of individuals in a given area, witness rabbits in Australia and skylarks in New Zealand. This may be due to very favourable conditions and to the absence of the enemies and other natural checks which kept the numbers down in the old country. Secondly there may be a marked increase in individual size and vigour, as seen in the gigantic dimensions attained by the European water-cress in New Zealand streams. But, contrary to widespread opinion, there is very little evidence of increase in variability or of change in habit. The big fact is that animals successfully naturalised in a new and different country remain very much the same as they were at home. There are probably subtle constitutional changes, such as the increase in the number of red blood corpuscles in men who settle at high altitudes, like Johannesburg, but there is not much visible change either in structure or in habit. Rats may take to tree-climbing in one country and to sewers in another, but these are trivial changes. And the same may be said of changes of diet in insects that invade a new area where the old food-plants are absent. Necessity is the spur of nutritive experiments. When a bird nests in a very strange place, such as a scarecrow, we should remember that it is not so strange to the bird as it seems to us.

The barnacle goose (*Bernicla sandwensis*) of the Hawaiian Islands has become entirely a land goose during the breeding season. Moreover, it shows an obstinate rigidity in always going back to the same breeding-place, an attachment which enemies, including hunters, recognize to their own advantage. Moreover, the parents are moulting when they lead the goslings about, so that they cannot fly away; and they have left the vicinity of the sea in which they used to find refuge. There are many instances of this sort of imperfection in habit-change. And the apparent imperfections become striking, though fallaciously so, when man enters into the plot. Thus the now much reduced elephant seal, once very abundant on Californian coasts, persisted in being



F. W. Bond

W. S. Berridge

WHITE-TAILED SEA EAGLE WHOSE DISAPPEARANCE AFFECTED THE FEEDING CUSTOM OF GULLS

At one time the sea or white-tailed eagle was common in the Isle of Man, on the Cumberland coast, in Ireland, and South Scotland, but during the latter part of the nineteenth century it became gradually killed off. The effect in so far as Great Britain is concerned of doing away with this strong bird, which is only a little smaller than the golden eagle, has been a multiplication of the creatures on which it fed, such as gulls. The gulls, fish-eaters pure and simple, being not only more numerous but having their convenient fishing grounds disturbed by intensive steam trawling, have taken to going inland to feed and have changed their diet of fish for seeds and grubs.

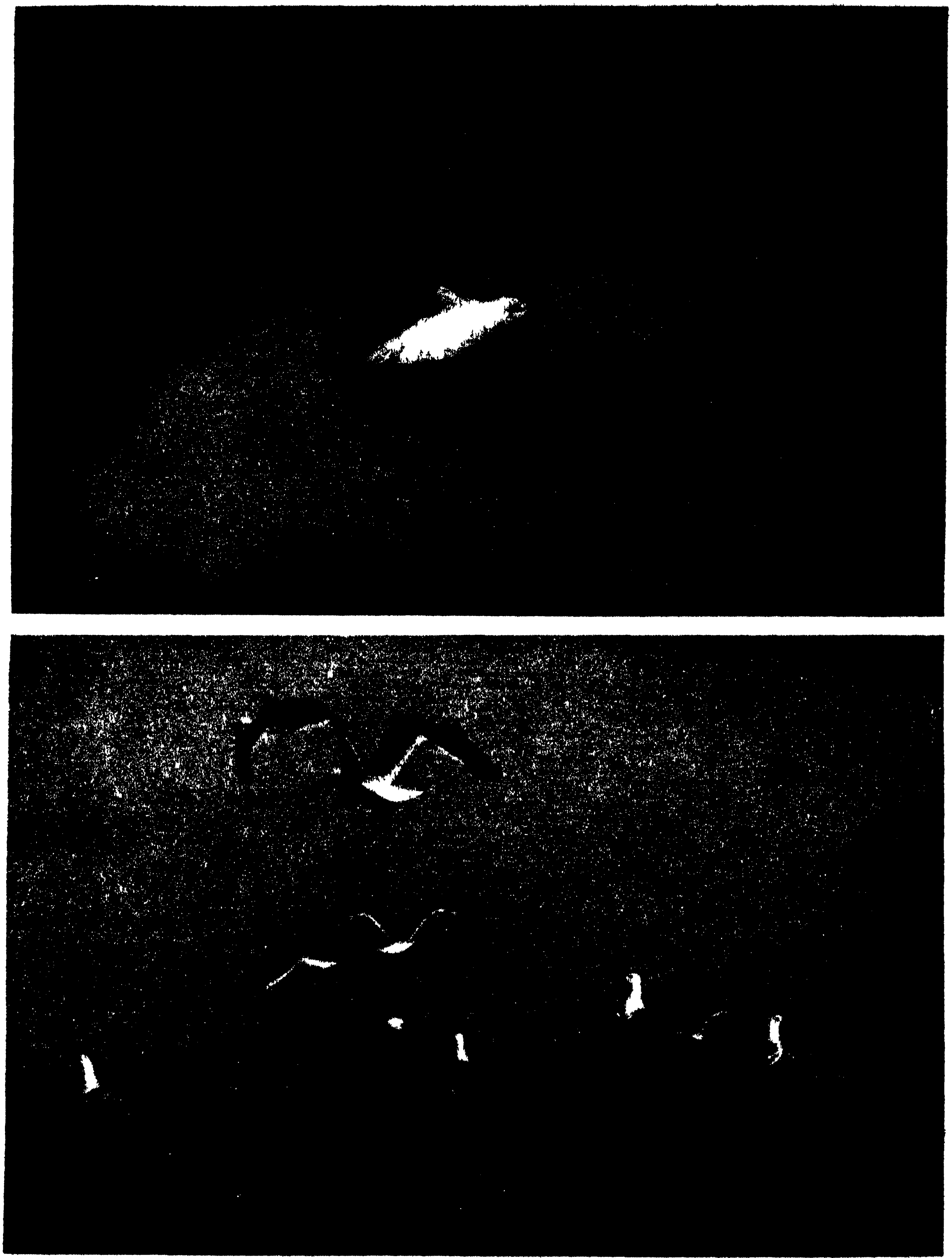
Arthur Brook Builth

RAVENS, A DIMINISHING RACE THAT PREYS ON YOUNG GULLS

Just as the sea eagle went, so is the raven going while the ten times more harmful rook has been encouraged to multiply tenfold The raven, a dweller among cliffs, has a great liking for young gulls in the season and in former times helped to keep the gull population within reasonable limits But owing to the comparative ease with which the bird can be trapped it has now become numbered among those British species that are diminishing This is one more reason for a surplus of gulls which must seek food inland

unafraid of man. But how can one expect giant animals to have a tradition of timidity? How can one expect animals that have held a position of security for tens of thousands of years to react adaptively to man's mischievousness in the course of a century? For thousands of years they have known no fear—is it any imperfection that they remain unafraid of a few men intruding from a ship's boat? We do not absolve them, so to speak, from being somnolent in security, but we cannot, with justice, think of them as stupid.

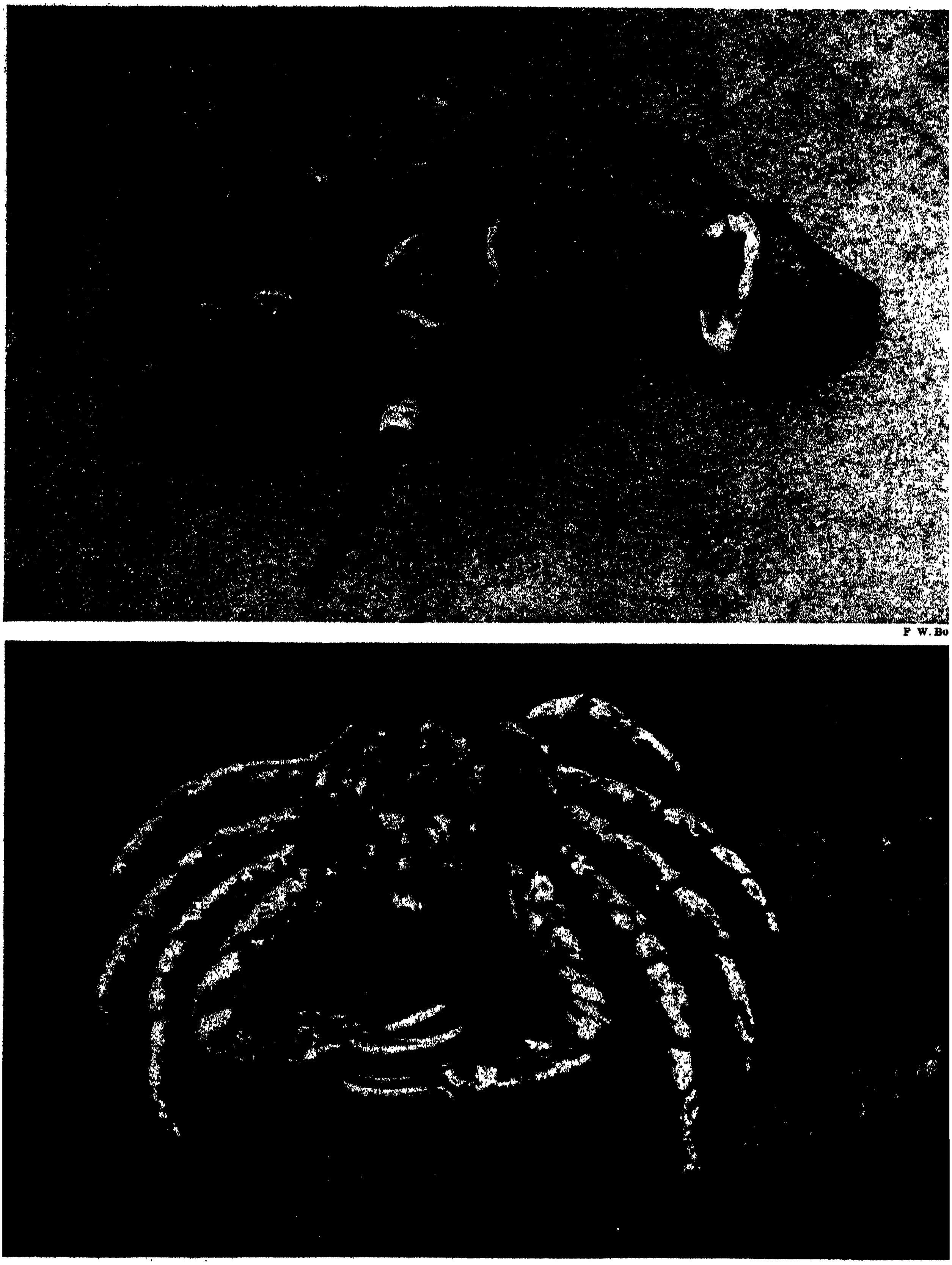
There is no doubt that animals can adjust themselves, and sometimes adapt themselves, to new conditions of life. There may be changes in structure and changes in habit. But since some animals are profitably plastic and others are fatally stereotyped we wish to emphasise our suggestion that those "habits" that are based on reflexes and instincts are very hard to change; while those that are based on intelligence and on individually-learned associations remain effectively plastic. The instinctive line of evolution leads to extraordinarily effective results, as in ants, bees, and wasps; but the intelligent line of evolution is the open path of educability



Oliver G. Pike

SEA GULLS WHICH VISIT THE FARMER'S FIELDS AND DESTROY CROPS

Herring gulls have become noticeably vegetarian in Scotland since 1900 owing to the diminution of their natural enemies. They, together with the lesser black-backed gull, shown in these photographs, are often seen in the harvest fields among root crops. The lesser black-backed gulls seen in the fields do a lot of good by eating harmful grubs but the herring gulls will dig up potatoes and eat the hearts out of turnips in a manner highly exasperating to the farmer who thus finds new pests added to the old list which was already too long.



F W. Bo

E.N.

CRABS THAT HAVE FORSAKEN THE SEA FOR A LIFE ASHORE

It must have taken the robber crabs and other land crabs many centuries to change from a sea habit to a land habit. We have two example of the change here. In the lower photograph is a land crab on Enderby Island, off the coast of West Australia, perched upon a plant. Th upper illustration shows us a robber or coconut crab which has climbed a tree, fetched down a coconut, broken the shell and is scoopin out the inside. And yet the ancestors of this creature, allied to the hermit crabs of the sea, were exclusively of the salt-water.

F Martin Duncan

J J Ward

HOUSE-FLY, CARRIER OF FILTH, AND THE COMPLEX TONGUE WITH WHICH IT FEEDS

House-flies, though not entirely unfriendly to man's interests, do so much more harm than good that they may be regarded as foes The good they do lies in their consumption of decaying animal matter when they are in the larval stage But these scavengers, when they reach the winged stage, still feed on filth and fly direct from it to perch on a baby's mouth or the food laid ready for a family meal. Apart from their revolting association with dirt, the house-flies are really dangerous as carriers of disease Filth adhering to their legs is trailed across our plates and our lumps of sugar. The right hand photograph (much magnified) shows the complex tongue of the house-fly through which it takes all its food On the left is the fly itself magnified

Chapter CIII

Flies That Are Foes and Flies That Are Friends

By John J. Ward

Author of "Insect Biographies"

The true flies have but one pair of wings, and belong to the order Diptera. Their hind wings are represented by a pair of tiny, stalked organs of drum-stick shape, known as halteres, or balancers. These rudimentary organs are conspicuous in the crane-fly, or daddy-long-legs, but are more or less concealed in some of the common flies; as in the case of the house-fly and the blow-fly, where they are covered with membraneous lobes, appendages of the upper pair of wings.

Apparently, these curious remnants of the lower pair of wings are an essential feature of the two-winged flies, for when they are removed the insect is no longer able to balance itself in the air. The name "balancers" is, therefore, well applied; so, indeed, is "halteres," it being the scientific name for the balancers, or weights, used by the Greek athletes while leaping. Since these balancers are so small that they can scarcely play any part in actual flight, it is probable that they function as sense organs; and there is some evidence to prove that they are used for auditory purposes.

Two other features worth noting regarding dipterous or two-winged flies are that they are not provided with biting mouth parts, and none is armed with a tail sting. Some people will maintain that they have been bitten by a house-fly, or stung by a gnat, both of which are impossible things, because the house-fly has only a sucking proboscis which cannot bite anything, while the gnat is entirely stingless. The female gnat, or mosquito (for the terms are synonymous), can, however, suck blood, for in addition to its sucking proboscis, like other blood-sucking diptera which we will consider later, it is provided with a beak consisting of six piercing lancets and probing instruments. These mouth parts, though, are entirely different from the lateral pair of biting mandibles which characterise beetles, wasps, bees, and other true biting insects, all of which bite sideways, not from above and below as mammals do. Many of the two-winged flies will be found to have a sharp-pointed tail of sting-like appearance, but that is an ovipositor, an organ used exclusively for egg depositing.

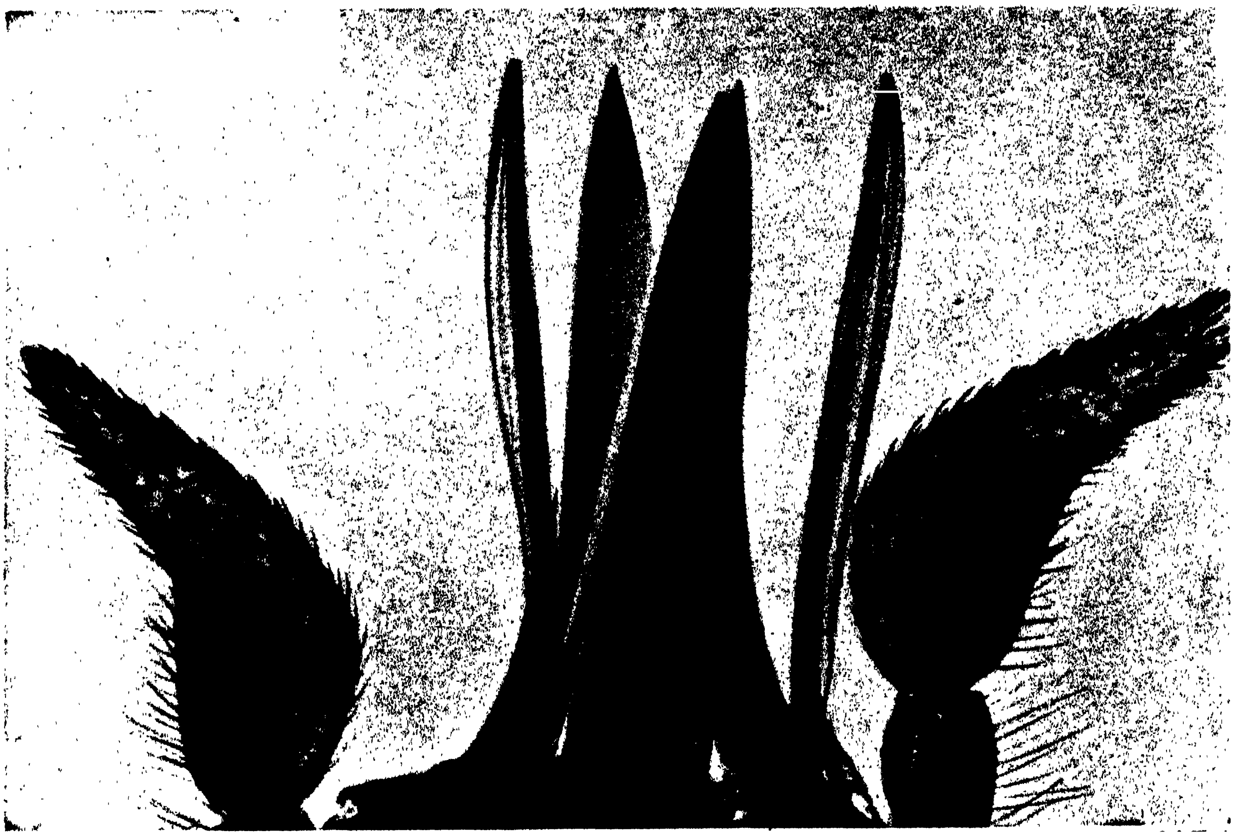
In point of numbers the dipterous flies hold precedence over all other kinds of insects, and when we are out in the garden, or in the fields, or woods, and are unmercifully attacked by a swarm of flies of numerous species, nearly all of which will be of the two-winged order, it is obvious that the intentions of the various species may be entirely different, for while some are out for blood, others may merely intend to absorb some of the perspiring moisture from our face c neck, and still others are probably joining in tl chase for mere amusement and the joy of life.

It is plain, therefore, that it is difficult to know wh is who in the fly world. A gadfly that looks like large house-fly may alight on your hand that holding a fishing-rod, and, while you watch it, driv into your flesh its piercing lancets with so slight prick that you scarcely know you have been woundec yet you may have a badly poisoned hand in consequence, owing to the lancets introducing poiso germs into the wound from the carrion on which th fly has been previously feeding. The drone-fly, c similar size, may also select your hand holding th rod just for a temporary resting-place; but, as i looks so bee-like, you quickly sweep it off, yet it i perfectly harmless, for it has only a tongue adapte for gathering pollen and nectar from the flowers.

Who, then, are friends, and who are foes in th motley crowd? They turn up each summer seaso from somewhere, but to discover that somewher means much persistent, and often unremunerative work by some hard-working entomologist. It wa two young medical men who, in 1898, proved tha in malaria-infested districts residents were quit safe from the disease so long as they protecte themselves from the attacks of mosquitoes.

Vast tracts of the earth's surface are rendere uninhabitable for civilized man by malaria an yellow fever, and, in 1897–98 Major Ross (now Si Ronald Ross) made the discovery that it was no the common grey gnat, or mosquito (*Culex*), tha conveyed the parasite of malaria, but the spot winged gnat (*Anopheles*). He found that th malaria parasite, when in the blood of a huma being, developed to a certain stage, and then neede the body of the mosquito to complete its life cycle The mosquito that sucked the blood of the infecte person could then convey the germ in its saliva t a healthy individual. The disease was, therefore proved as not contagious, or infectious.

After this definite proof by Ross regarding malaria eminent medical men of the United States of America proved that the terrible yellow fever was, likewise, not conveyed by infected persons, but solely by the brindled gnat (*Aedes calopus*, or, as it was then named, *Stegomyia fasciata*). As a consequence, in 1900–1901, during the American occupation of Cuba, Major Gorgas, in one year, changed the city of Havana from a hotbed of disease with an annual death-rate of 750 to a healthy town with the death-rate figure as low as six. In 1904 he set to work in



MOUTH PARTS OF THE GADFLY THAT ATTACKS BOTH CATTLE AND MEN

When a gadfly bites a distinct stab is felt in the flesh, and this photograph shows the apparatus which the fly—only the female " bites "—uses to produce the stab and the subsequent and very irritating swelling round the puncture. On the outside are the hairy antennae not unlike the claws of a crab to look at. Then come the probing instruments and lancets for making the puncture. This fly, which looks like a house-fly save that it is grey and an inch long, buzzes loudly. But its smaller relative, the cleg , arrives upon one's hand in silence.

the malaria and yellow fever infested area of the Isthmus of Panama. The French had failed in their efforts to cut the canal, with an estimated cost of 25,000 lives, and enormous financial losses, owing to these diseases. Then Colonel Gorgas took the situation in hand. He made it a crime for anyone to leave unscreened anything in the nature of puddles, shallow pools, or utensils containing standing water where aquatic gnat larvae could thrive. With drainage of land, and oil floating on the surface of water that could not be drained, and screening hospitals of fever patients with gauze, the battle was fought—and won. The diseases were effectually stamped out, and the army of some 40,000 labourers had, at the end of 1913, safely cut a connecting way of fifty miles length between the Atlantic and Pacific Oceans, saving a voyage of 8,000 miles round Cape Horn. To-day, the area of the Panama is free from yellow fever and malaria, and its people are robust and healthy.

These same malaria mosquitoes (*Anopheles*) in England may meet and attack us any summer evening, but, since they have not the connecting link of the malaria patient, they can do no more than inflict a painful puncture like that of our common grey gnat (*Culex*). There are twenty or more kinds of British gnats, some of which never appear to attack human beings and seem harmless enough; although we have to remember that all their life stories have not yet been fully investigated.

There are other blood-sucking insects known as midges (*Ceratopogon*), barely visible to the eye, which can cause us much pain and inflamed swellings that may trouble us for days afterwards. On the other hand, there are numerous midges whose only crime is that they may get into our eyes while we are motoring; but whether that is the fault of the midge-fly, or otherwise, is a very debatable point.

When we consider the larger flies of the gnat-like type, we turn to the crane-flies, or daddy-long-legs (*Tipulidae*). The long legs of these insects always seem to be more troublesome than useful to them when we see them come indoors and fly round the lights up against the ceiling, or when climbing a window pane. To appreciate their utility we have to see the fly at work in its natural home amongst the grasses in the fields—or more particularly on the lawn.

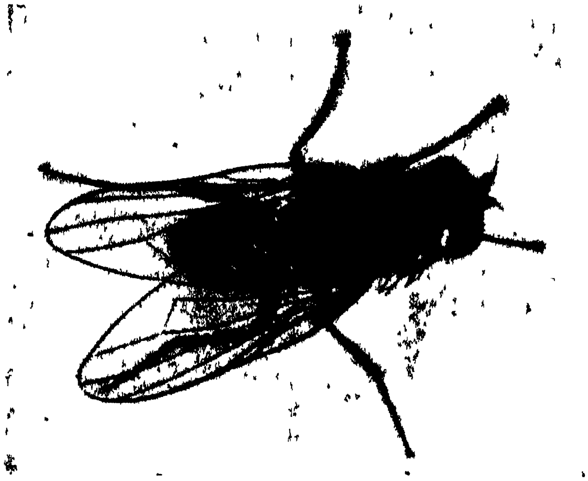
The female insect may be readily distinguished by her sharp-pointed tail, that of the male being blunt with a pair of lappets. When laying her eggs, she digs her sharp ovipositor into the ground while

J J Ward

F Martin Duncan

TWO FLIES THAT ARE FRIENDS OF MAN FLESH-FLY AND DRONE-FLY

In these photographs we have two flies that are friends Below is a specimen of *Sacophagia carnaria*, the common flesh-fly, which in its larval stage preys upon locusts. Above are two photographs of the drone-fly (left) showing it seeking its food on a flower and (right) among plants on the ground. This belongs to the large and interesting family called *Syrphidae* none of whose members is harmful, while many are distinctly helpful in devouring plant lice. In all these photographs, of course, the insects are shown magnified.



J J Ward

H S. Cheavin

LESSER HOUSE-FLY AND LARVA

In the early summer small flies appear in houses and these insects are often thought to be "young" house-flies. But, of course, flies do not grow, and these little flies belong actually to another and smaller species. (Photographs enlarged.)

holding herself in an upright position. Then, twisting round amongst the grass blades by means of her long legs, she drills the hole and places several eggs about one quarter of an inch below the surface. She then travels a short distance with the combined action of her "stilts" and wings, and selects another spot for a further batch of eggs.

Since she has to deposit between 200 and 300 eggs, it is obvious that these long legs are just the right working tools for this occupation. There is always the danger, too, that a toad or a lizard may discover the crane-fly while she is egg-depositing. With so much leg action going on, the chances are that the food-catching tongue of those creatures will most likely get a stray leg, which the crane-fly can afford to lose with but little inconvenience, and, while the enemy is discovering that it has secured the "shadow," the substance is able to make its escape.

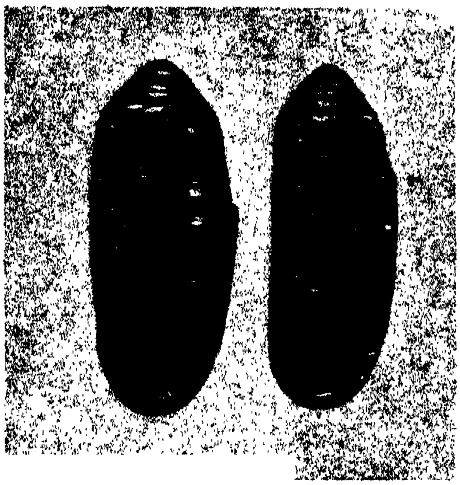
The eggs eventually hatch out the grubs which, later on, we recognize as "leather jackets," which gnaw away at the roots of the grasses with their horny jaws, often doing enormous damage to grassland. We therefore have to regard the familiar daddy-long-legs and all his tribe (for there are various species) as being amongst our foes, even though we cannot bring any charge of blood-sucking against him

When we turn to the flies of the more ordinary type we find ourselves up against a host of species that vary considerably both in colour and size. The largest is the gadfly (*Tabanus bovinus*), of grey colour, and nearly an inch in length, looking like a very large house-fly. This insect possesses formidable mouth parts which consist of strong blades and probing instruments for blood-sucking purposes, all of which are ensheathed in the gutter of a fleshy, sucking proboscis. Both man and beast are attacked by means of these instruments, and they readily pierce Scotch tweed or flannel clothing.

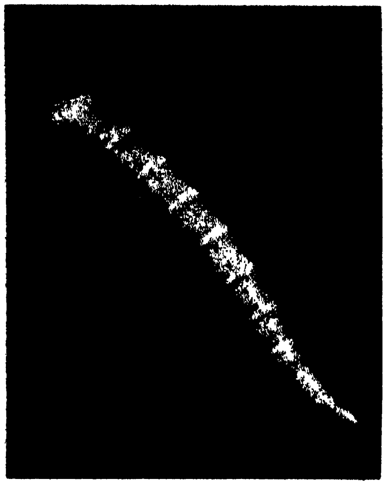
THERE is a smaller and commoner gadfly, known as the cleg-fly (*Hoematopota pluvialis*), which is much slower in flight, and it approaches you in the woods without the fierce buzzing sound of its larger relative. It is therefore able to get in its puncture quite unsuspectedly. As in the case of the mosquitoes, it is the female insect that is the blood-sucker, the males not being provided with lancets.

Bot-flies (*Oestridae*) are always dangerous foes of our domestic animals, each species having its particular host. They are not blood-suckers, indeed, their mouth parts are often so much reduced that they cannot feed at all. Their business is to place their eggs, and sometimes their living larvae, into their host animals; the sheep bot-fly into the nostrils of that animal; the horse-bot fly on the hairs, so that the horse can lick them off and pass them to its stomach; and the ox-bot, or warble-fly, beneath the hide. They are some of the worst foes of the stock-owners; while the damage to hides from the "warble" (which is a hole made by the fly larva for breathing purposes) is estimated for Britain at from three to six million pounds annually.

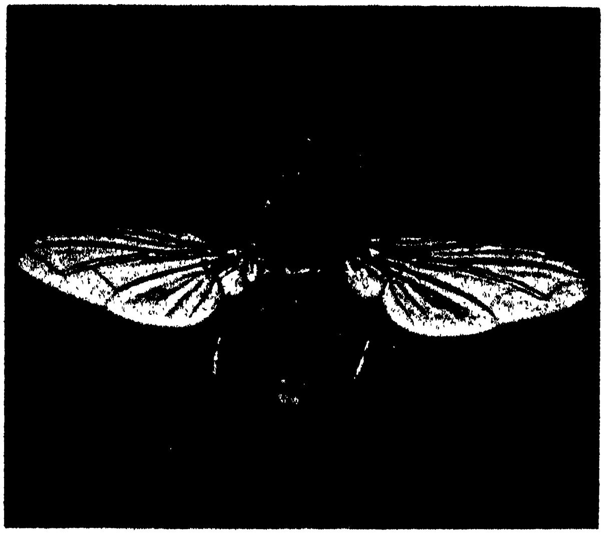
House-fly with eggs just laid



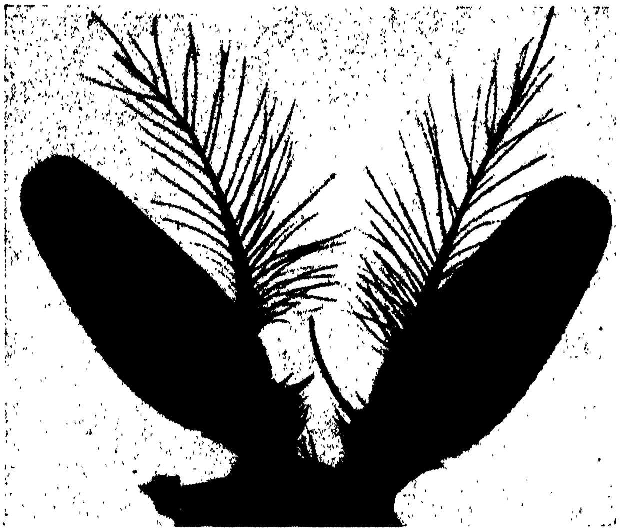
Pupa of house-fly, magnified



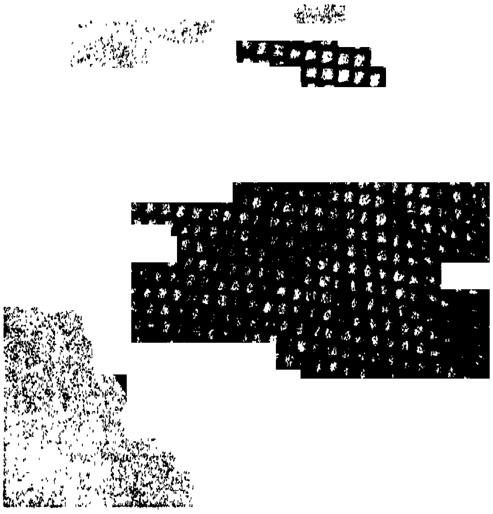
House-fly larva, enlarged



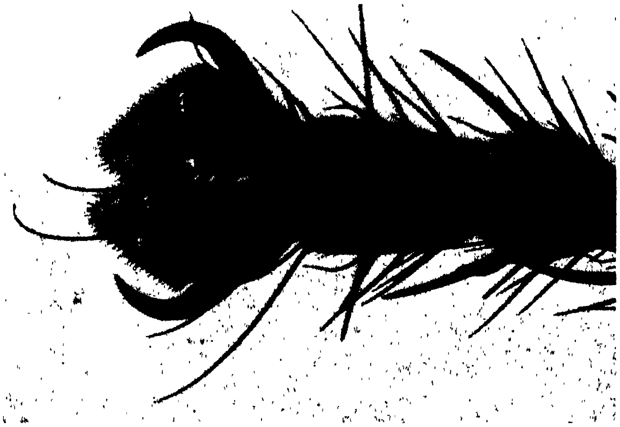
House-fly, much magnified



Antennae of feelers of house-fly



Part of a house-fly's compound eye



Magnified foot of house-fly

HOUSE-FLY AT CLOSE QUARTERS AND ITS LIFE STORY

Wherever human beings are found there will also be the house-fly, the foulest of living things. Attracted by means of its keen sensitiveness to odour,

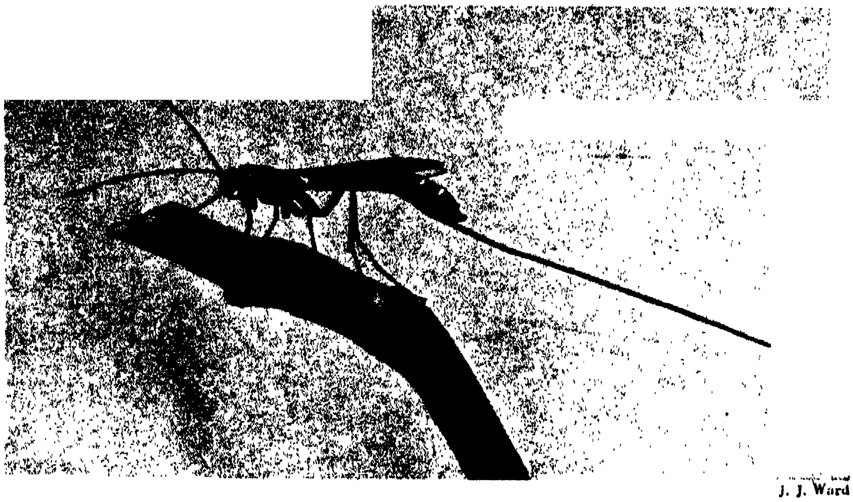
house-fly. There are special

A. H. Willford

F. Martin Duncan

BLOW FLIES BANQUETING OFF A STINKHORN FUNGUS: ANOTHER MEMBER OF THE "BLUE-BOTTLE" FAMILY

One of the most annoying of the flies that pester humans in their homes is the blow fly, or "blue-bottle." This possesses a remarkably keen sense of detecting the presence of dead meat—it may be the corpse of a mouse or rat, or the family joint. The female blow-fly seeks out the meat in which to lay her eggs, which she can do at the rate of seven a minute. If baulked from alighting on a joint by a wire-gauze cover she will drop her eggs through the mesh of the wire so that they fall on the meat. Blow flies are also very fond of the fungus called stinkhorn, and in the left-hand photograph we see a number of them gorging themselves with the rotting stuff. On the right is another member of the family—*Calliphora vomitoria* (enlarged).



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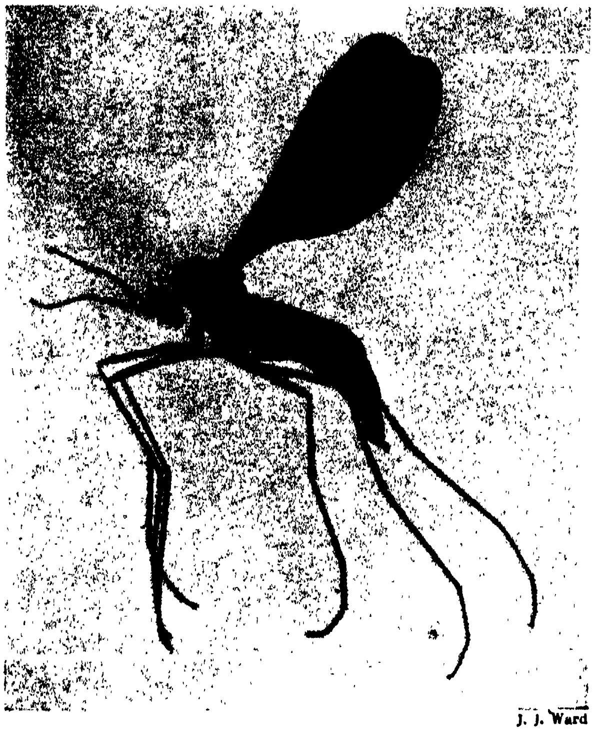
The blow-fly, or blue-bottle (*Calliphora erythrocephala*), is the largest fly that is usually found in our houses. Its loud buzzing generally announces its arrival, and its keen sense of smell directs it to seek our dinner joint. Should the meat be unprotected, the blow-fly loses no time in getting to work. I can personally testify that it will deposit seven eggs in one minute. The eggs are of a pale cream colour and, under a magnifying lens, remind one of skinned bananas, excepting that they have a glossy surface.



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HESSIAN AND ICHNEUMON FLIES

The Hessian-fly (bottom) attacks the barley and the wheat while the long-tailed ichneumon-fly (top) has a specially long ovipositor which it inserts into the borings and lays its eggs on the bodies of the grubs inside. The photographs are enlarged.

Should the meat food in the larder be covered with a wire gauze cover, and be near the network, the blow-fly will drop its eggs on, and between, the wires. It is obvious, therefore, that the best use of wire netting is at the larder window, rather than on the meat itself, as then the blow-fly cannot enter.

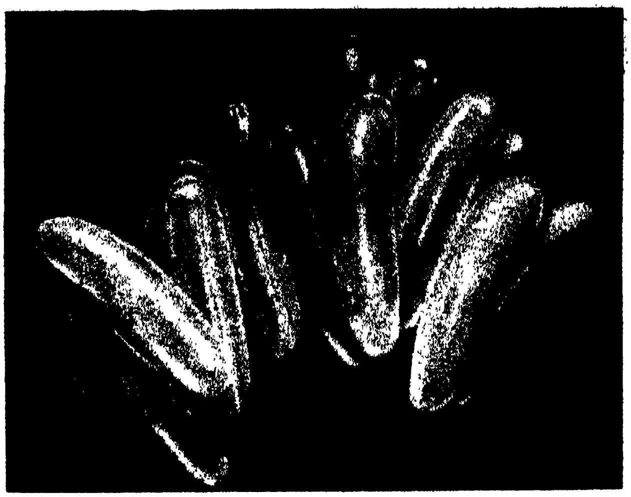
In the open the blow-fly is not only able to find dead animals on which to deposit its eggs, but, by some marvellous instinct, it is able to anticipate the death of its quarry; for trapped animals such as hedgehogs, rabbits, stoats, birds, and what not, while still alive, are sometimes covered with blow-fly eggs.

The eggs hatch in about twelve hours during summer weather, and the maggots (the "gentles" of the fisherman) at once proceed to devour their food supply. In just over a week they are full-fed, and change to the pupal stage, which lasts about fifteen days. A new generation appears in from three to four weeks.

Belonging to the same family (*Muscidae*) are the green-bottle flies (*Lucilia*) with much the same habits, but some species of which deposit their eggs on the wool of sheep that are badly kept, causing much trouble to the stock-keeper. There is also the flesh-fly (*Sacrophaga carnaria*) which does not produce eggs but live maggots. These flies are more often found in the open, but will enter houses that lack cleanliness and contain animal food.

The ordinary house-fly (*Musca domestica*) in England is but rarely seen before the end of June; although a slightly smaller species (*Fannia canicularis*), with a jerky flight, may be quite abundant indoors during May and June. These smaller flies are often mistaken for young flies, but flies, like all other winged insects, do not grow; their growth is finished when they attain the winged state. Later in the summer the common house-fly is represented at about ninety per cent to each hundred found in the house. Both these flies have similar habits, the eggs being deposited very largely in stable refuse; probably ninety per cent of them are reared in stable manure heaps. In towns of late years flies have become more and more reduced in numbers, owing to stable yards being replaced by garages. Whenever flies are found in abundance in a town area, it is almost certain that there is a stable in the near vicinity; although a few are reared during warm weather in rubbish heaps of vegetable and other garbage where fermentation is going on.

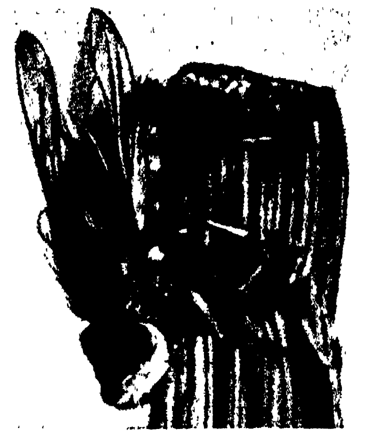
Under favourable conditions the maggot of the house-fly will mature in about six days, and the pupal stage lasts another four or five days. So that from egg to fly stage is only some ten or eleven days. In hot weather new generations appear at about fortnightly intervals: and as each female fly can deposit more than one hundred eggs at one laying, and during



Eggs of blow-fly, magnified

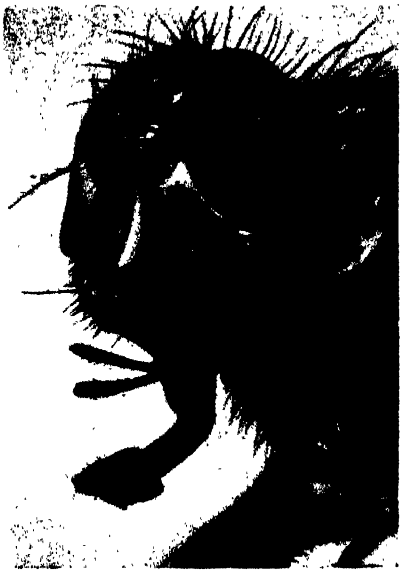
Changes of blow-fly pupa (left) to maggot (right)

Blow-fly maggot or "gentle"



Blow-fly just emerged, magnified

Blow-fly ready for flight



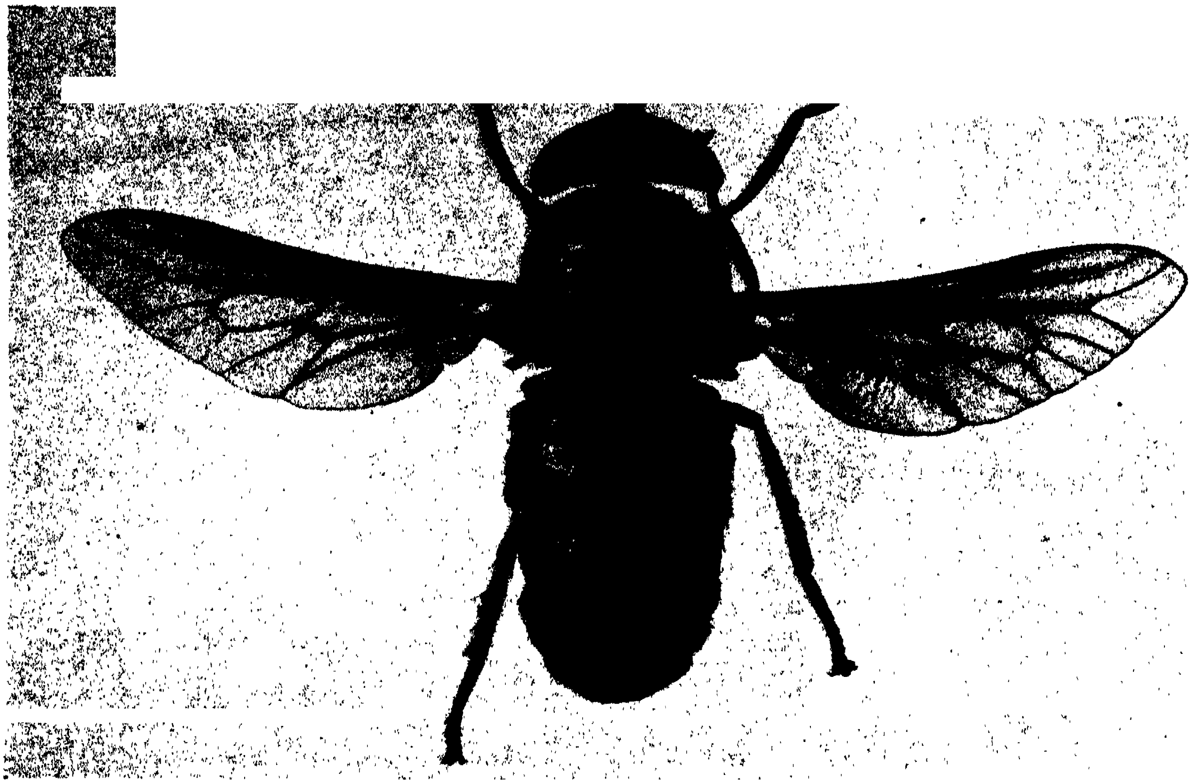
Head of blow-fly much magnified

Base of blow-fly's wing

Foot of blow-fly

MICRO-PHOTOGRAPHY SHOWS THE BLOW-FLY IN FULL DETAIL

The blow-fly or blue-bottle has wonderful compound eyes in its head (bottom left) and a long, sucking proboscis. The bottom centre photograph shows the base of a blow-fly's wing. The ribs in the wing are hollow tubes and the wing membrane is spread over both sides and covered with minute hairs. In the middle row of illustrations the centre photograph shows a specimen which has just emerged from its pupa skin. Notice the inflated skin of the "face." The fly blows this up in order to break through the pupa skin. Photographs by J. J Ward



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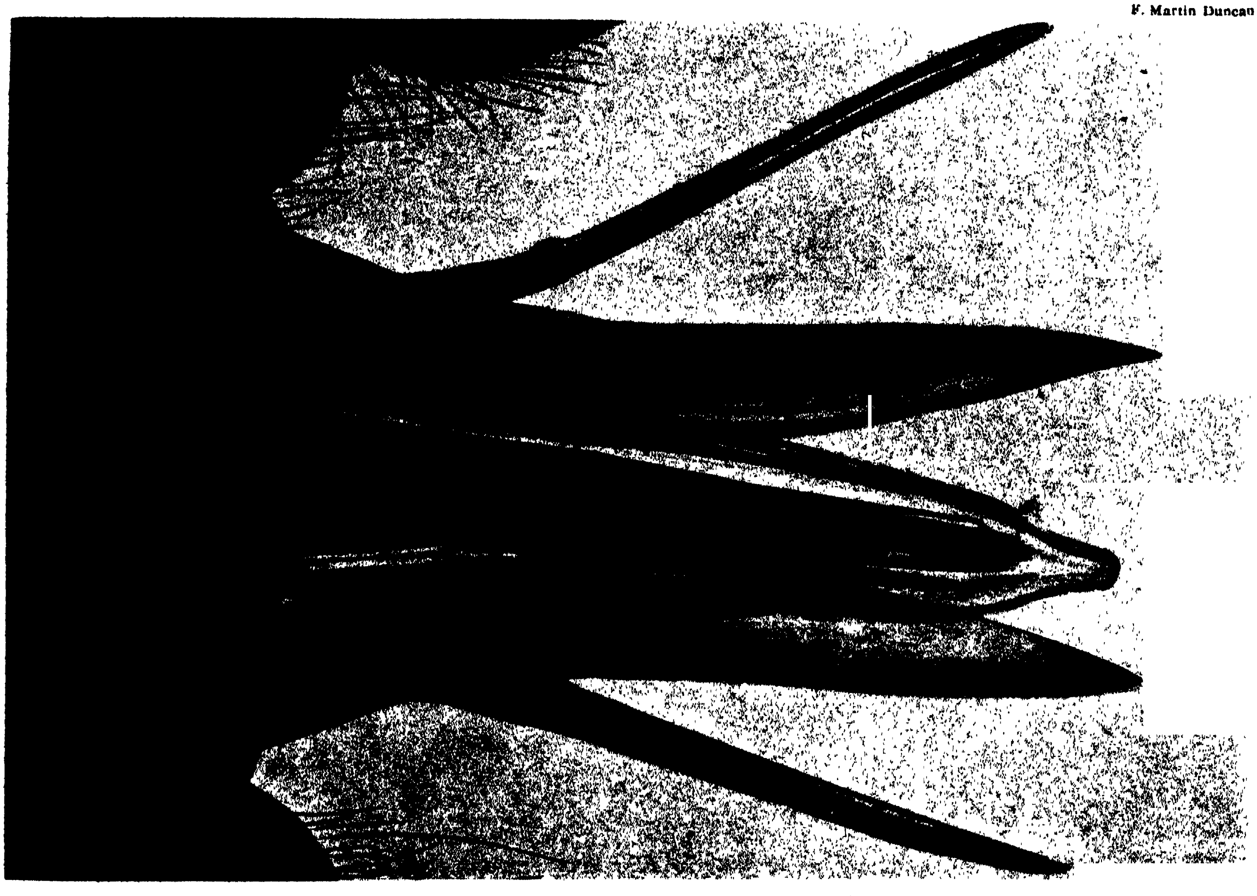


GADFLY AND THE SHARP LANCET WITH WHICH IT DRAWS BLOOD

Since it is made for piercing the thick hides of cattle the lancet of a gadfly (bottom) can very easily pierce a sock or a stocking and cloth as well. A photograph on page 1160 shows the entire mouth parts of the gadfly, but here we have a more highly magnified photograph to show the detail of this remarkable organ which is the cause of so much discomfort to man and beast. In Britain, luckily, the bite does not usually leave an infected wound. The upper photograph shows the whole insect and is considerably enlarged.

Egg of hover-fly, magnified

Larva capturing aphid

Lifting aphid from flower

Extending body for feeding

Larva of hover-fly on chrysanthemum leaf

Young hover-fly feeding on aphid larger than itself

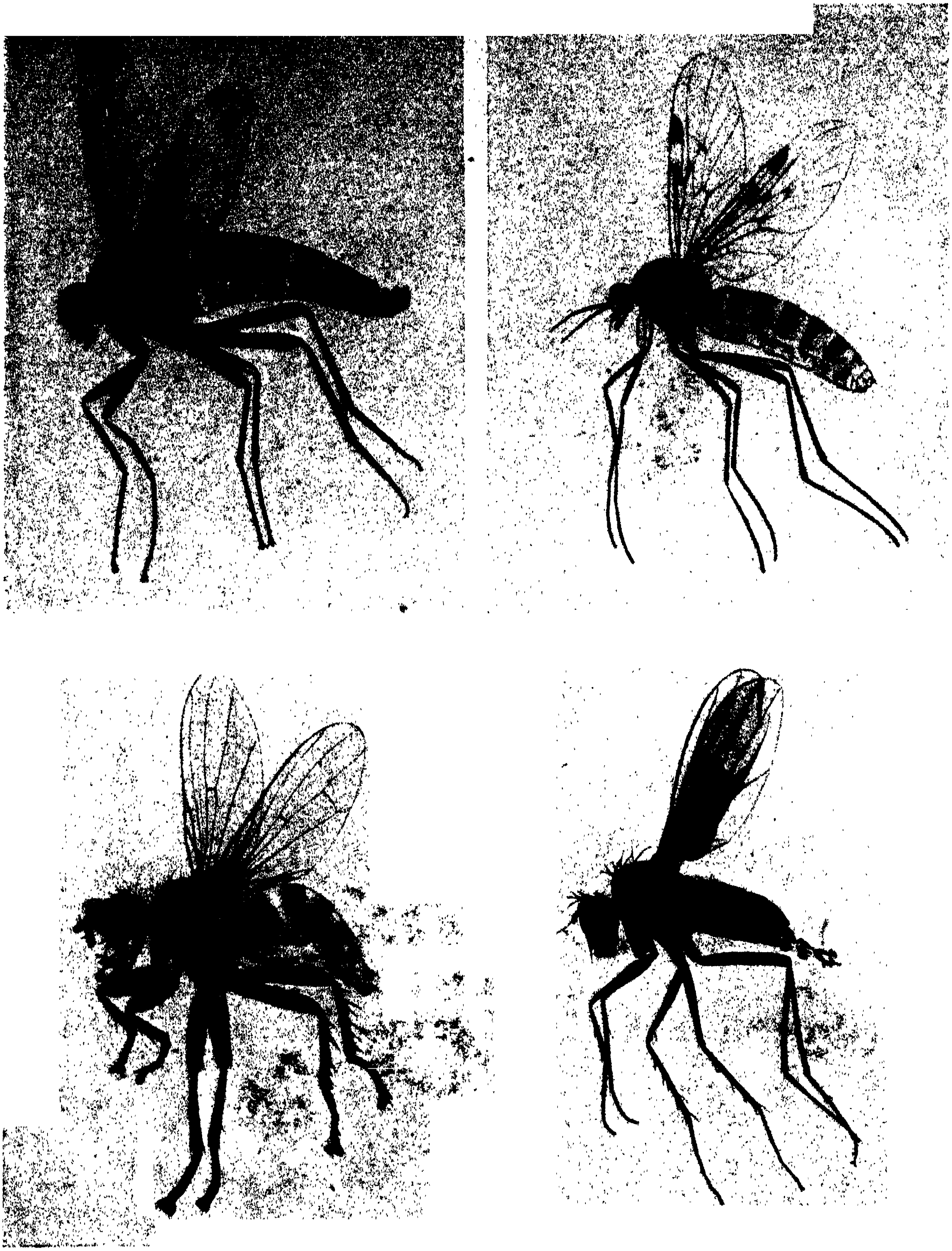
Hover-fly grub with captured aphid

Hover-fly just emerged from pupa

Hover-fly feeding on poppy pollen

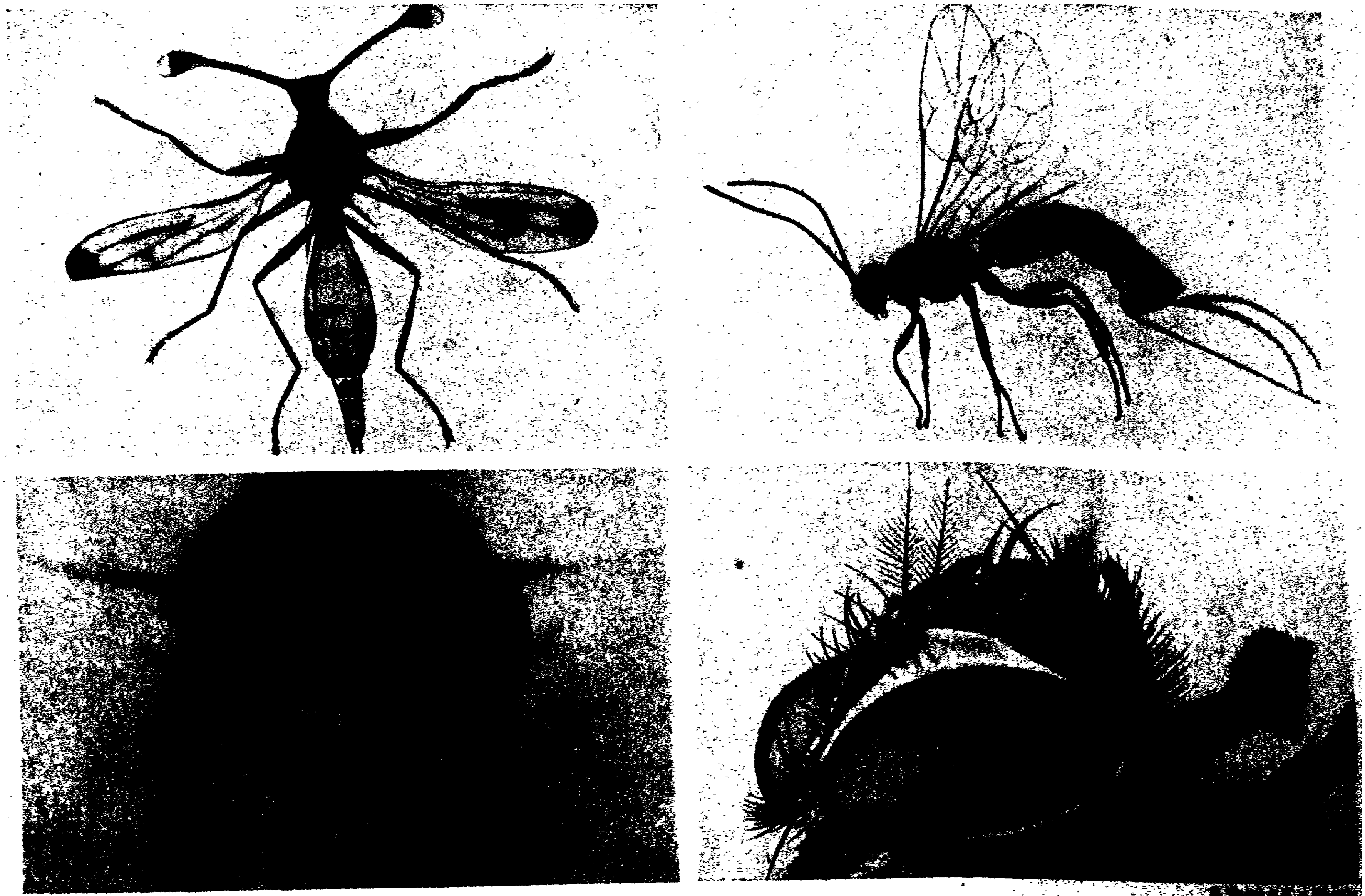
HOVER-FLY WHOSE LARVAE ARE WONDERFUL EATERS OF GREEN-FLY

In a country garden on a bright day a number of small flies may be observed which hang in the air, with rapidly vibrating wings, make a dart out of one's way and hover again. These are the hover-flies, and some of them are banded in black and yellow like small wasps. They feed on pollen and flower nectar, but their larvae, flat-bodied blind grubs, do immense good by wandering about on plants and spearing green-fly with their nose-probes. We see one (bottom left) in the act here. Photographs by J. J. Ward.



MARSH, BOG, DOWNHILL, AND WINDOW FLIES THAT ARE FRIENDS

The marsh fly (bottom left), whose scientific name is *Scatophaga stercoraria*, is one of the dung flies, and lays its eggs in the droppings of horses and cattle. Here are also the bog fly, *Campsiconemus curvipes* (bottom right), the downhill fly, *Leptis scolopacia* (top left), which is found beside streams and ditches in early summer and preys on harmful insects, while its larvae attack grubs; and the window fly, *Rhyphus fenestralis* (top right). This last is found on windows in houses and outhouses, the larvae being manure scavengers. Photos by H. S. Cheavin.



FLIES THAT PREY ON MAN AND HIS BELONGINGS AND FLIES THAT PREY ON OTHER FLIES

Painful and sometimes even poisonous are the bites of the blood-sucking great gadfly (bottom left). This is a large grey insect about an inch long whose lancets can pierce cloth quite easily, since they are constructed for getting through the rough hides of oxen. The right-hand bottom photograph gives us a side view of a blowfly's head. The stalk-eyed fly (top left) which comes from Natal, has its head produced into two lateral stalks which bear the eyes. On the first pair of legs there are toothed edges used for crushing the insect's prey. The ichneumon [illegible] lays its eggs on the bodies of various destructive grubs so that, when the larvae hatch they eatup the grub. Photographs much magnified.

its life can repeat that effort some five or six times, it is obvious why flies become so abundant as the summer advances.

In a limited way and in certain circumstances we may regard both house-flies and blow-flies as friends, for in their larval stage they are powerful scavengers whose work is purely that of removing dead animal and other decaying matter, which, if left, would become a potent factor in disseminating disease germs. There is, however, the difficulty that they possess a taste for food that is similar to our own, and that they visit our dining-tables immediately after leaving the unsavoury material which they utilise in their economy. We have, therefore, to regard these flies as enemies to prevent contamination of our food.

As previously stated, the house-fly's mouth-parts cannot inflict any injury to our skin, but there is its relation the stable-fly (*Stomoxys calcitrans*), of outdoor habits, and very like a house-fly in appearance, but which is provided with piercing mouth-parts, and it occasionally comes indoors. It is this fly that sometimes causes people to think that they have been bitten by a house-fly. The stable-fly is nearly related to the tsetse-flies (*Glossinia*) of tropical Africa, which are carriers of the parasite of the sleeping sickness disease.

If we enter the garden, we are at once confronted by flies of innumerable species. We may disturb a buzzing mass of what look like house-flies from the top of a gooseberry bush; but, if we investigate more closely, we find that these flies are more hairy on their bodies. They are tachnid-flies (*Tachininae*) and, if we search the branches of the gooseberry bush, we shall probably find them infested with the caterpillars of the destructive magpie moth, and these tachnids are engaged in placing their eggs on the bodies of these larvae. The maggots that come from their eggs burrow into the tissues of the caterpillars, which are usually able to pupate in their cocoon of threads; but, instead of developing into the pupa of the moth, the cocoon more often produces from two to three pupae of these parasitic flies. Here, then, we have a fly which, to all appearances is an ordinary house-fly, but this time it is a real insect friend of man. Amongst the flowers all sorts of flies are busily

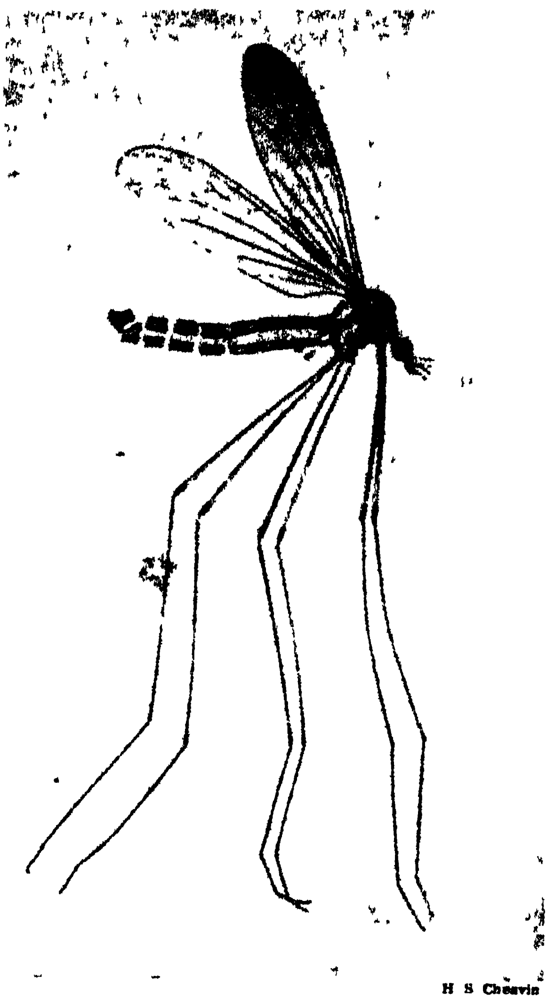
J. J Ward

"CLOSE-UPS" OF THE HOVER-FLY AND THE GADFLY

The lower photograph shows the delicate antennae of a hover-fly, which resembles a little wasp. The upper photographs show (left) the deadly probe of a gadfly and (right) the head and huge dark eye of the same insect. These photographs are much enlarged

occupied, and these, for the greater part, are again our friends, for they assist in the pollination of the blooms. Always conspicuous amongst them are the bee-like drone-flies sipping the sweets of all kinds of flowers. If we have a quick eye we may see a still more bee-like insect hovering over the primroses and probing their depths with its long, stiff proboscis while still on the wing. It is one of the bee-flies (*Bombyliidae*), which have hairy bodies and resemble humble bees. They possess marvellous powers of flight, and, at the slightest movement, they seem to vanish into space from the flower on which they may be feeding.

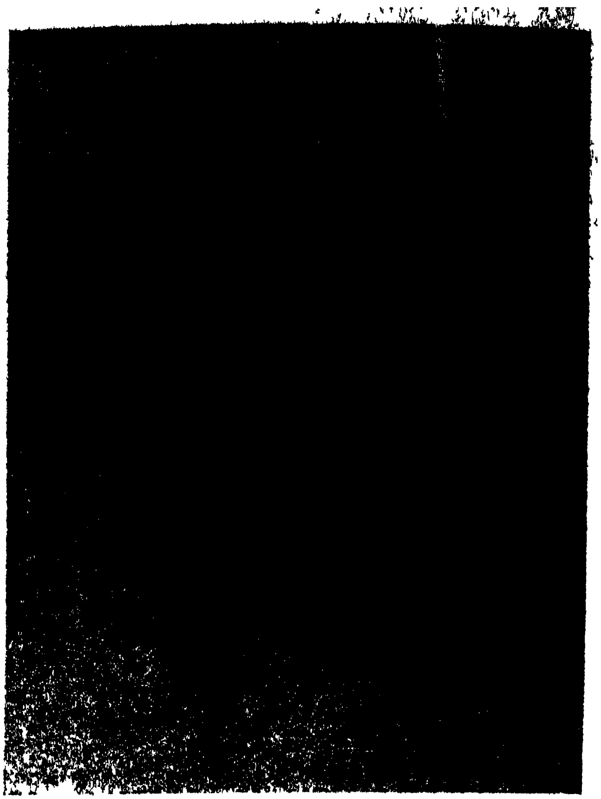
On every side, too, we shall find the abundant hover-flies (*Syrphidae*), many of them poised in the air almost motionless on rapidly vibrating wings. Some of them are striped black and yellow, looking like small-sized wasps. They feast on the pollen and nectar of the flowers, and their eggs are placed on the foliage of their food plants. The grubs that emerge from the eggs prowl about the plant and capture aphides; they are flat-bodied, and both blind and footless, but can loop their way about the leaves. As they move about, they are continually thrusting their pointed foreparts here and there with considerable rapidity; and sooner or later they spear a green-fly with their nose probe. When the capture is made, the grub lifts the aphid clear of the leaf and elevates it in the air, while it sucks its juices like drinking from a bottle. It then casts aside the empty skin of its victim and goes in search of another. When hungry, it can drain green-flies dry at the rate of one per minute, and it feeds both day and night.



H S Cheavin

A MALE "DADDY-LONG-LEGS"

Leather-jackets—the white, fat grubs which eventually grow into the clumsy insects we know as "daddy long legs," do immense harm to turf and crops by eating away the roots Here we see a view of the adult male from the side, magnified.



I. J Ward

CRANE-FLY THAT BREEDS A DESTRUCTIVE GRUB

A way of getting rid of the "daddy-long-legs" grub was accidentally discovered at Bournemouth A hose was left running on a rubber mat on a bowling green The grubs to avoid saturation sheltered under the mat when they could be easily destroyed.

From what has been written here, it will be obvious that there are good flies and bad flies, but to make sure of their identity presents a very difficult problem. As it is, the flies that are the friends of humanity are often confused with the flies that are foes, and worse still, the harm done by the latter is not generally recognised to the extent that it should be. Identifying the true nature of these insects is, of course, only possible after careful study. More than forty thousand species of the two-winged flies have been recognized, and it is estimated that the unrecognized groups will eventually make the total fully three hundred and fifty thousand species. Perhaps I need offer no further apology for the omission of some species from this chapter.

Chapter CIV

The Universal Fight for Food

By J. R. Ainsworth-Davis

Formerly Professor of Zoology, University of Wales

T[illegible] summarised in the phrase "food and love," in other words the preservation of the individual and the continuance of the species. We are here concerned with the former only. Food is essential for repair of waste, growth, and the production of the energy enabling movement and all other vital actions. Hunger warns when food is necessary, while the senses of taste and smell make feeding pleasurable; otherwise no animal would bother about eating.

The world is one vast larder, providing an immense variety of bills-of-fare appealing to the most varied tastes, but not to be enjoyed without serious competition. Everywhere we can observe a strenuous "fight for food," much of it tragical in nature, for many animals prey upon their fellows in the most relentless fashion. The shape, structure and habits of any particular animal have been evolved with reference to securing food of some sort, and there are three kinds of diet—meaty, vegetable and "mixed," with the first of which this chapter deals.

Ground feeders include many flesh-eating or carnivorous animals that depend on living prey, none more so than some members of the cat family, which are very perfect engines of destruction. Lions and tigers, for example, in every detail of their structure, are adapted to a predaceous life. The specialised teeth include powerful canines for seizing and holding victims, blade-like flesh-teeth for cutting, and small front teeth used as scrapers in conjunction with the rough rasping tongue. Auxiliary weapons of offence are found in the strong claws, and these are kept sharp by being drawn back into sheaths when not in use. In spite of their enormous strength lions and tigers adopt a stealthy method of approach, relying on the sense of sight, and when sufficiently near a victim secure it by a sudden spring. The khaki colour of a lion and the striped markings of a tiger harmonise with their surroundings so perfectly as to make the owners extremely inconspicuous to those animals that are being stalked. Though these lordly cats take pride of place among flesh-eating forms that seek their meals upon the ground, they are more than equalled in ferocity by some of the carnivorous mammals inferior to them in size. The fossa of Madagascar, the snake-destroying mongooses (the "rikki-tikkis" of Kipling), and the British weasels and stoats, were they as large as lions, would be far more awe-inspiring, and test to the utmost the courage of big game hunters. Wolves and their kind have discovered the value of co-operation, hunting as they do in packs, and following their prey by scent rather than sight.

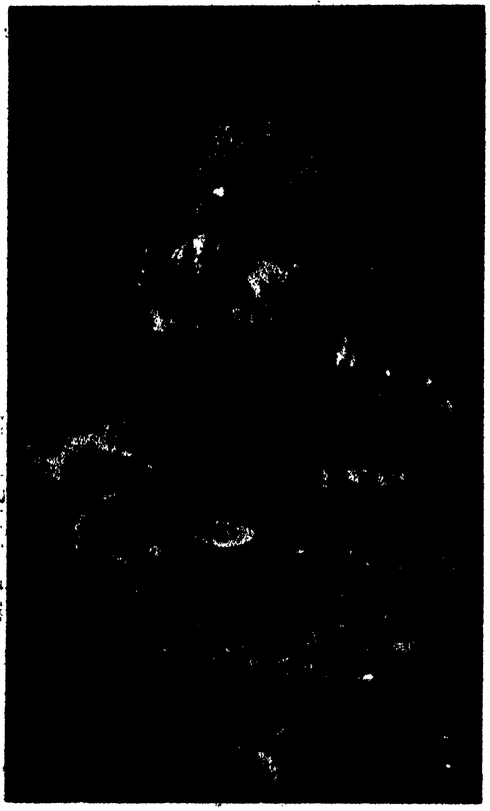
Some ground mammals are specially adapted for feeding on insects, a striking example being the great ant-eater of South America, which raids ant-hills with its curved, powerful claws, and secures their denizens by means of a long sticky tongue protruded from the long toothless snout.

Many of the carnivorous birds are also ground feeders, one of the most notable cases being that of the secretary bird of East Africa, which destroys large numbers of venomous serpents. Lizards and snakes, among reptiles, glide and slither through dense vegetation in search of prey. Some of the large ground lizards are formidable creatures, especially the Komodo dragons, described in an earlier chapter of this work, of which examples can now be seen in the London Zoo.

For such a life the limbless snakes are well adapted, and with them the practice of "bolting" food is carried to an extreme, as when a loudly protesting frog is slowly swallowed as a meal by a common grass-snake.

The frog himself, and his cousin the toad, slimy-skinned amphibia which begin life as aquatic tadpoles, also affect a meat diet. They possess a long sticky tongue, attached to the front of the floor of the mouth, and this can be shot out with lightning speed to secure unwary insects.

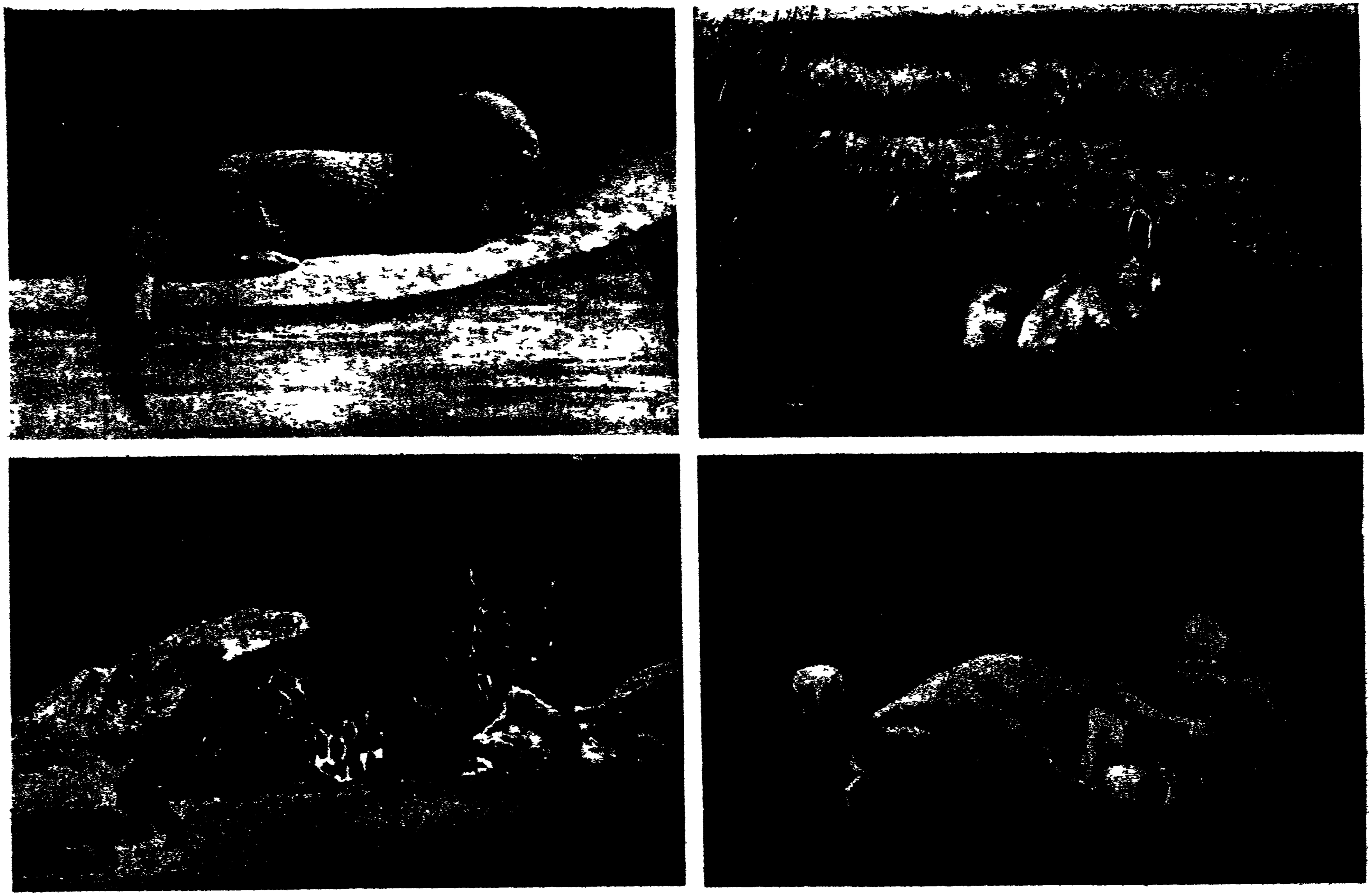
Upon the ground we also find many rapacious insects, such as the tiger beetles, while the driver ants of tropical Africa travel across country in dense columns, devouring small



E.N.A.

FOOD FOR THE HAWK

Rabbits are regarded by humans as creatures to be killed—for sport or because they are a nuisance to farming. But to other creatures, the hawk for instance, they are a necessary part of the available "menu."



DIFFERENT PHASES OF THE FOOD FIGHT: LEOPARD, PIG, OTTER AND RABBIT

Getting food is either a case of struggling with other members of the same kind or with the cunning of the prey selected. Our left-hand bottom photograph shows a leopard which has succeeded in capturing a bird. By this act, perhaps, the lives of a thousand caterpillars or flies are saved and the doom of so many plants sealed. Quite another kind of fight is also exemplified here (bottom right). The young draw their life from their mother, but she makes no attempt at "fairness." If the stronger brother shoves aside the weaker, she takes no notice. Above are (top left) an otter with a fish and (top right) a rabbit browsing grass The latter in coming out to feed often becomes food for human beings. Photographs by E.N.A.

mammals, caterpillars, and so forth. Highly carnivorous, too, are hunting spiders, scorpions and centipedes.

Many peaceful vegetarian forms, of varied kind, have endeavoured to escape from the pitiless struggle for existence to which they were exposed on the surface of the ground by taking to the trees as a refuge, where, too, the homes of many birds are constructed as a relatively safe shelter for helpless nestlings. Predaceous animals, following their example, have invented climbing devices of many kinds for taking advantage of this overhead dinner table Leopards and smaller creatures of the cat kind have adopted such a mode of life, and they often possess spotted coats harmonising admirably with the dappled pattern caused by sunlight shining through foliage. The leopard, too, and this also applies to some of the large climbing snakes such as anacondas, finds his mode of life doubly advantageous, for not only are arboreal animals available as food, but also ground forms which come near enough to his lurking place aloft to be secured by a spring just at the psychological moment.

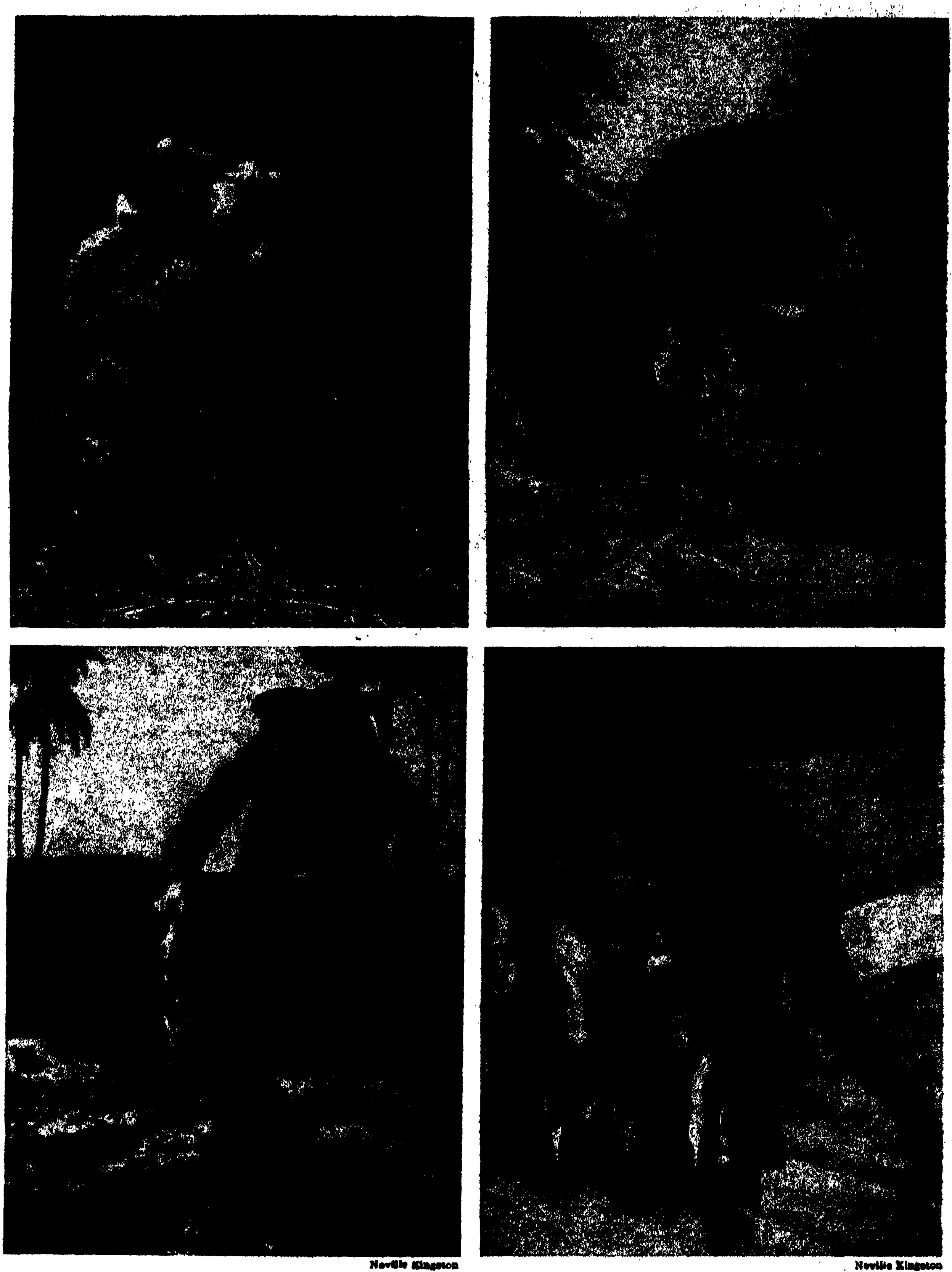
GIRAFFE AND ITS PROTRUSIVE UPPER LIP

There seems no end to the ingenious ways of assisting the art of food-getting among animals The giraffe has not only an amazingly long neck for reaching the upper foliage of trees that no other animal can get at, but also a protrusive upper lip which adds a few inches " reach " to this already grotesquely tall animal. Here we see the lip in operation.

Insect life abounds in trees, and is eagerly sought by climbing lizards, including the sluggish, colour-changing chameleon with its sticky tongue, and such birds as tits and woodpeckers. Many of the insects are themselves predaceous. The great bird-eating spider of South America also lies in wait for prey above the surface of the ground. The webs and snares woven by many of his smaller relatives are found at various heights, and their construction is often elaborate. In this respect the common garden spider is a mistress of craft, and her web is extremely beautiful. (The male is an idle waster.) Vegetation in hot countries may also be infested by blood-sucking leeches and ticks.

Mother Earth has been sought as a refuge by many vegetarians, but here again they have been followed by relentless foes. Rabbits and field voles are pursued underground by weasels, while earthworms and grubs have no peace. Many birds in particular probe for them from above, and here we see the practical value of the long bill of a woodcock or kiwi. That " little gentleman in velvet," the mole, is no mere prober, but a thoroughgoing underground hunter of untiring and ferocious nature. Shaped like a rounded wedge, he ploughs his way through the ground by means of powerful digging extremities, and the short glossy fur offers the minimum of friction, for it has no " set," the hairs growing out at right angles to the surface. A mole devours more than its own weight of animal food every day, and furnishes a kind of " larder " for the benefit of its young, this consisting of earthworms whose heads have been bitten off.

The conquest of the air was first achieved by insects, who began as parachutists and ended as aeronauts. After vainly endeavouring to shake off their enemies by learning to climb, they took to flight as a final resort. Some of them, however, became carnivorous, and adopted the reprehensible

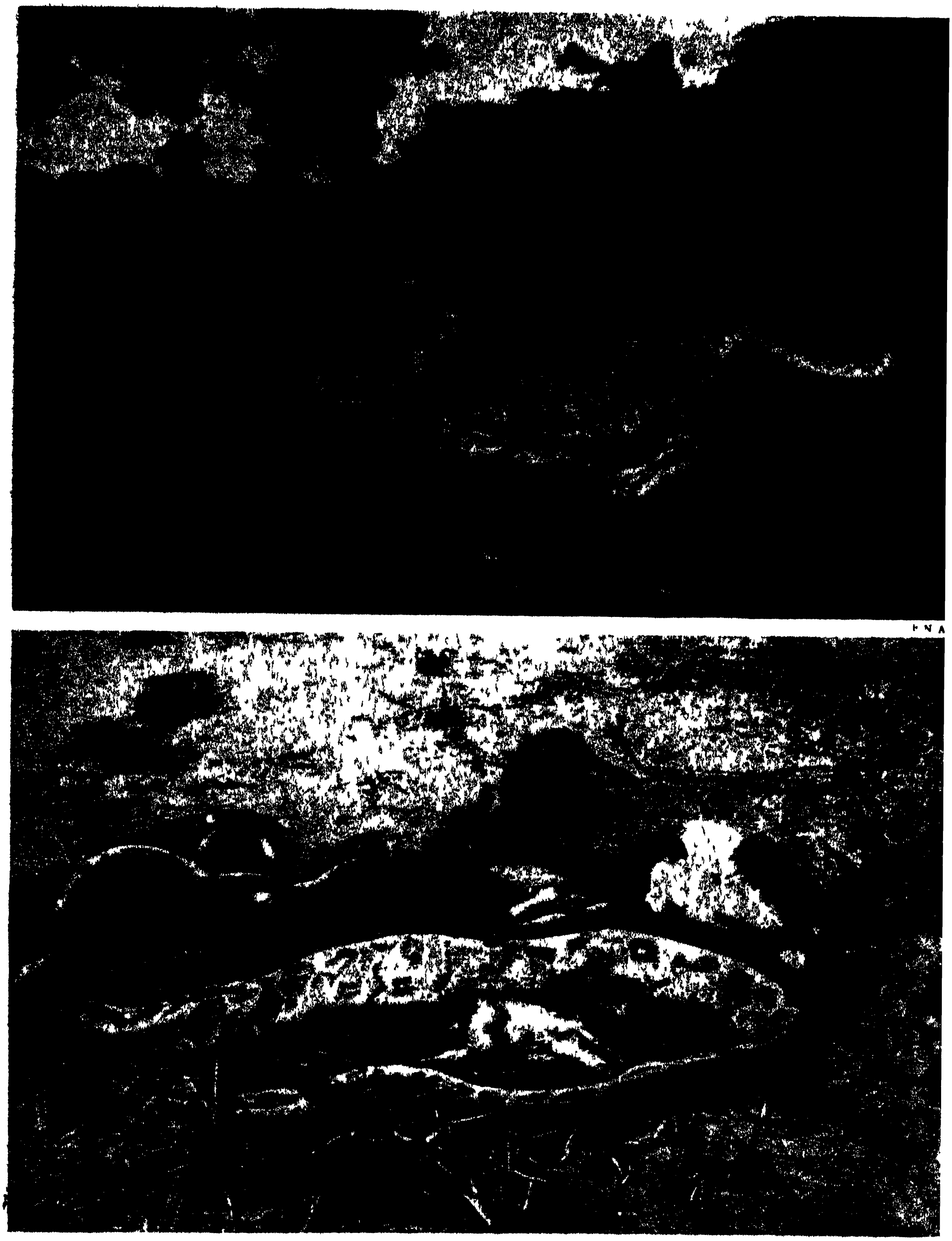


Neville Kingston

Neville Kingston

TAME AND SEMI-TAME ANIMALS AND HOW THEY GET THEIR FOOD

Feeding is a serious business and hence it is remarkable that even dogs can be trained to take food without "snatching" at it. The task of feeding animals in captivity is one which needs all the keepers' wits. An alligator (bottom left), even when young, can snap uncomfortably so as to include both the food and the hand that holds it. The other illustrations show (bottom right) a party of penguins; (top left) a bear of British Columbia which has found a "can"; and (top right) a young hippo.

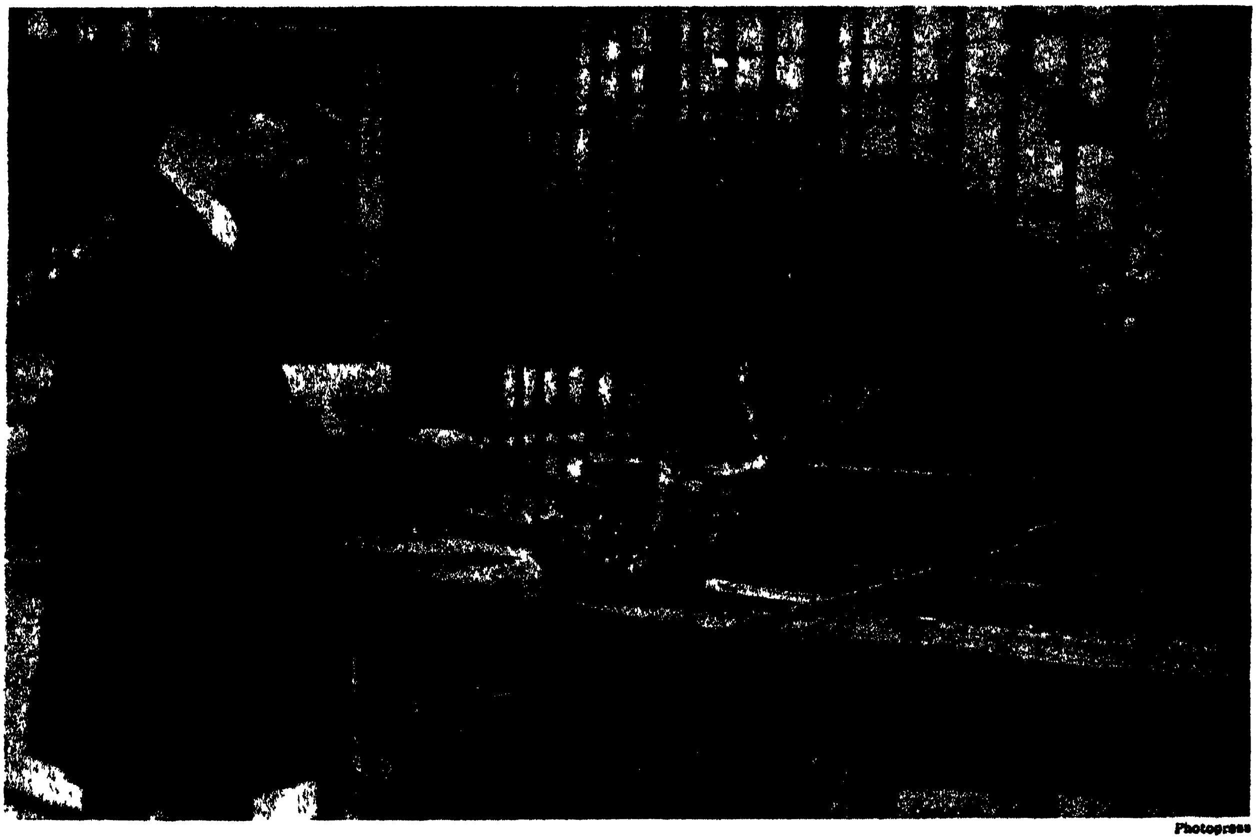


F N A

PYTHON AND YOUNG LION SUCCEED IN GETTING SUPPER

From the banks of the Zambesi comes the lower photograph and, indeed, in such a place one might expect to see almost anything Here is a huge python which has had the luck to come across a number of antelopes which have been drowned and washed ashore The giant snake has already devoured one and is about to turn its attention to the other six—or as many of them as suit Above is a young lion "snapped" while chewing the carcase of an aard vark (see also p 1078)

James



Photopress

INSTINCT TO FIGHT FOR FOOD SURVIVES EVEN YEARS OF CAPTIVITY

The instinct, deep down in the animal mind, to take no chances is shown in the lower photograph of a lion at the London Zoo taking its afternoon ration from the keeper. When the meat comes and a bar is removed from a special part of the cage to admit the meal, the animal cannot wait until the food is poked inside. It must stretch out an eager claw and seize what has to do for its "prey." Above are a brace of pelicans striving to eat the same morsel. Note the attitude they have to adopt in order to pick up the piece of food.

Mondiale

E.N.A

STRIVING FOR SUSTENANCE AGAINST DIFFICULTY: WILD BOAR AND ELEPHANT

When winter comes, those animals that do not get over the difficulty of the food-shortage by going to sleep till the spring have a hard time of it. Our lower photograph shows a number of wild boars in one of the forests of Hanover, looking in the snow for such food as they can manage to get. The elephant is a gargantuan feeder for it has the largest frame of any land animal to sustain, and it all has to be done on grass. The illustration (top) shows a fine bull elephant of Rajputana which has snatched a trunkful despite the urgings of its mahout.

practice of preying upon their kindred. The dragon flies are a striking example, and can be seen hawking for prey over ponds and streams. They fly with extraordinary swiftness, and their legs are bent forwards for the entanglement of victims, which are speedily dealt with, inedible parts, such as the wings of a butterfly, being shorn off by their powerful jaws.

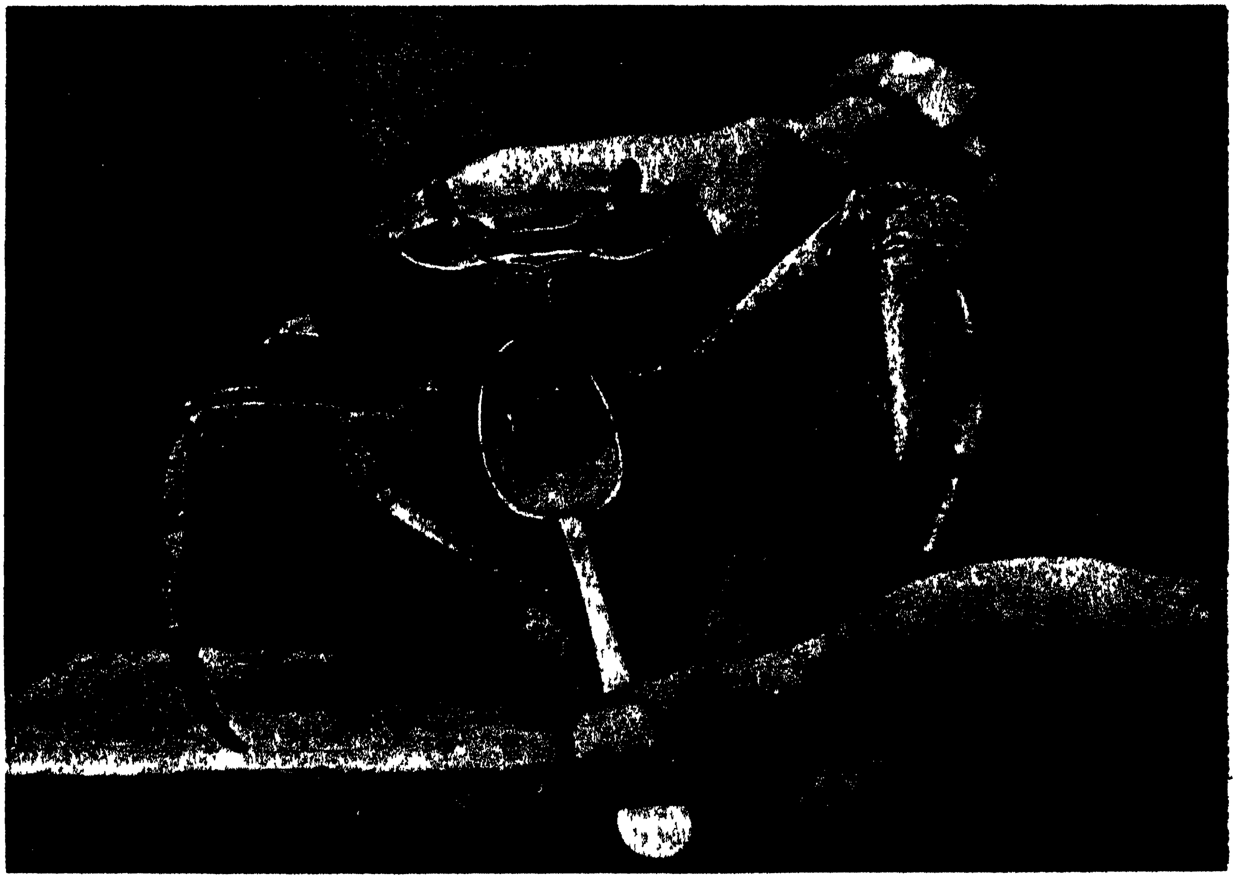
BATS, among mammals, have acquired the power of flight, and most of them are insectivorous. The solitary predaceous insects known as sand wasps are remarkable for the way in which they provide " larders " for the use of their young, which they are never destined to see. After laying their eggs in holes in the ground or specially constructed nests, they store these with caterpillars, adult insects, or spiders, previously stinging them in the nerve cord so as to paralyse but not kill them. The kind of victim selected for this storage varies with the particular species of sand wasp.

The little ichneumon-flies provide for their young in different fashion. By means of a piercing structure on the abdomen they lay their eggs in caterpillars, chrysalids, or even the eggs of other insects, so that the larvae hatch out in actually living larders.

The innumerable hosts of blood-sucking insects make themselves peculiarly objectionable in the fight for animal food. Mosquitoes spread malarial diseases in tropical and sub-tropical regions by infecting their victims with microscopical parasites belonging to the animal kingdom, while the dreaded tsetse flies of Africa set up the fatal " fly disease " (nagana) in cattle and horses, and the no less dangerous " sleeping sickness " in human beings, in somewhat similar fashion.

Birds, evolved from a branch of the reptilian stock, followed insects into the air, and many of them have become adapted to the pursuit of these pioneer aeronauts. Swallows, martins, and goatsuckers, to mention no others, take heavy toll of insect life. If all the insectivorous birds were suddenly to become extinct the world would soon be overrun by insects, and the existence of man himself would be seriously threatened.

The birds of prey, provided with powerful hooked beaks and strong talons, eagles, hawks and falcons, and owls of many sorts and sizes, devour vast numbers of other birds, small ground mammals, and sundry reptiles. Storks and the like turn their attention to frogs and other amphibians. Shrikes, or " butcher



SPOON-FEEDING THE CRAB, A DAUNTLESS SCAVENGER OF THE SEASHORE

Feeding a crab with a spoon seems rather a domestic sort of business. But there is no fiercer fighter for its food than the crab. One may get a very convincing example of this in setting a night line for fish. When the tide is out and fresh bait is put upon the hooks it is quite likely that one may be interrupted by a scurrying over the rocks and there will then appear a dozen or more crabs with claws raised, and they will go at once, without hesitation, to the hooks and tear the bait from them, unafraid

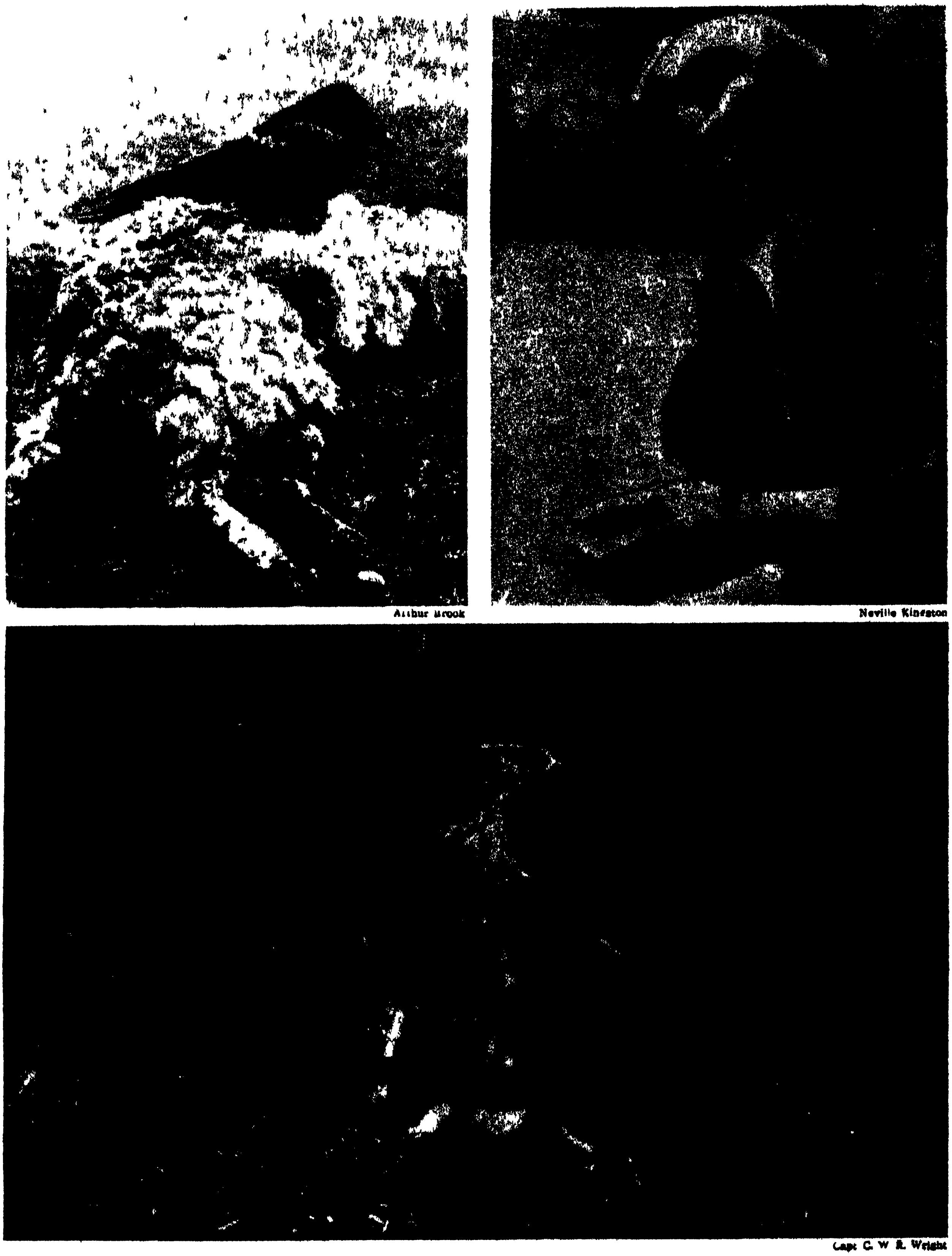
Lynwood M. Chace

AMERICAN RED-TAILED HAWK DEVOURING A DUCK

At first sight it seems that—as between bird and bird—the odds are all on the hawk. But, upon closer study, it is found that the hawk has to work very hard for most of its meals. Weak or sickly birds fall a comparatively easy prey, but to secure a healthy specimen takes all the strength and cunning of which the bird of prey is capable. A wild duck does not waste time on the wing. But here is a crafty hawk which has contrived to catch one for supper. The photograph was taken in America.

birds," of which one species is common in Britain, are notable among larder-makers. They impale mice, small birds, lizards, frogs, and chafers on thorns near their usual feeding places, thus creating a miniature shambles. Hence their common English name and also their scientific one of Lanius, which is simply the Latin for butcher.

The struggle for existence is rather less strenuous in rivers, lakes and ponds than elsewhere, so that many refugees from land and sea have taken to fresh water, while numerous insects spend there the earlier stages of their lives. But complete tranquillity and repose form no part of the scheme of life, and the fresh waters of the land are happy hunting-grounds for a great variety of extremely predatory creatures.



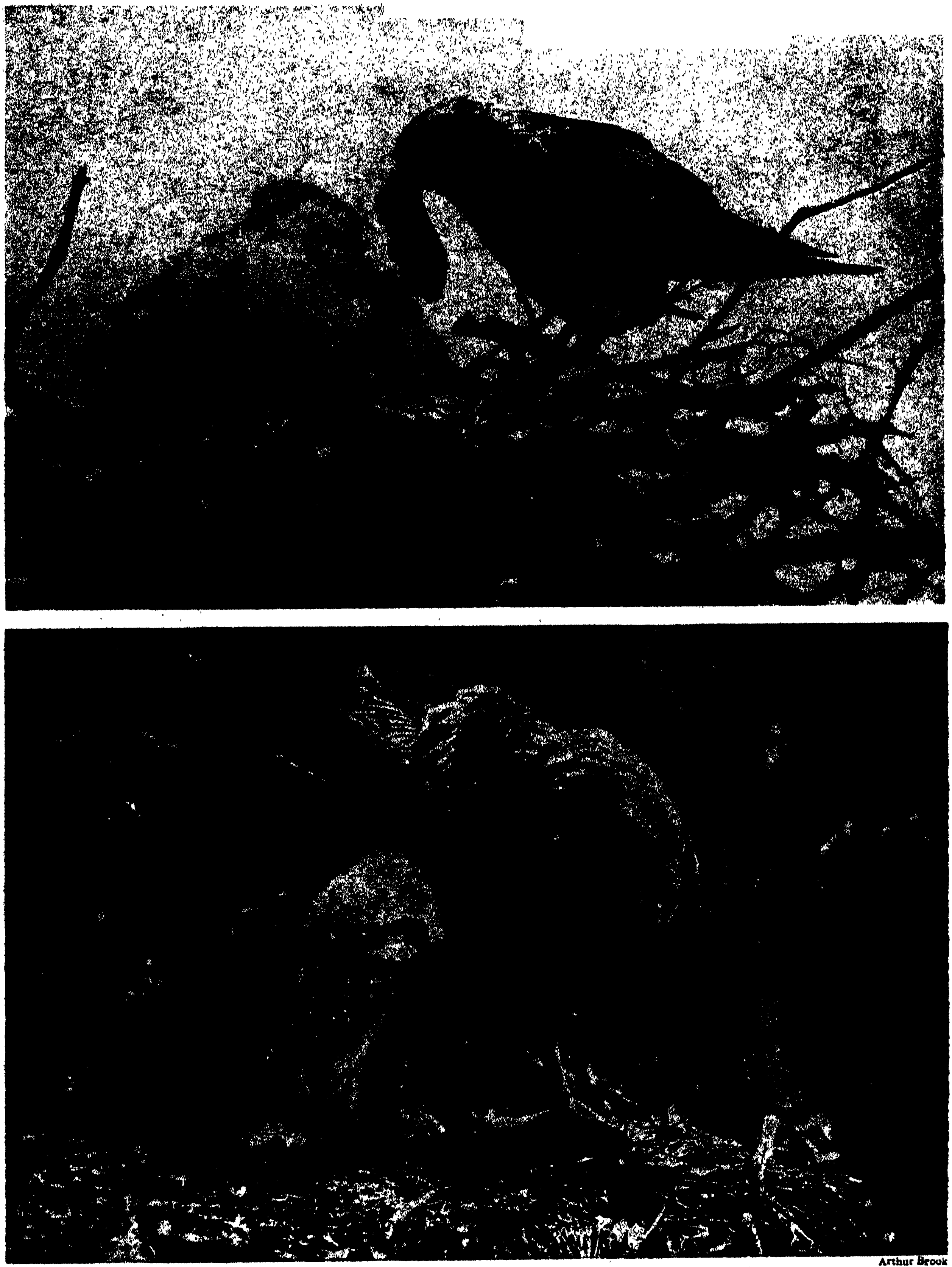
Arthur Brook

Neville Kingston

Capt. C. W. R. Wright

GOSHAWK AND THE RARE CARRION CROW, HUNGRY FOR THEIR MEAL

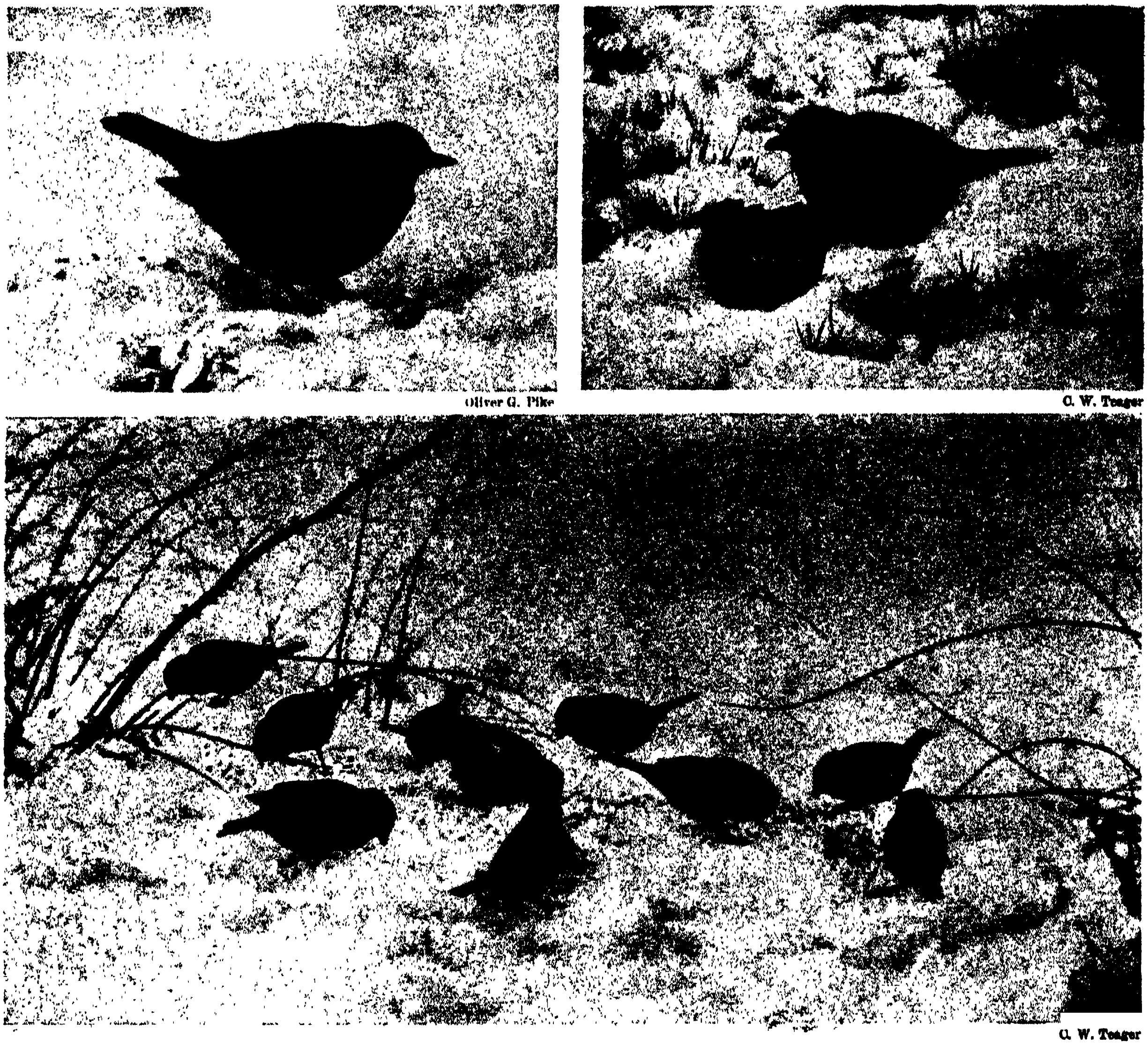
Gamekeepers, who habitually shoot the goshawk on sight as a destroyer of game and therefore an implacable enemy, might well observe the bottom photograph in which a goshawk is seen with a stoat that it has just struck down and killed. Above we see (left) a carrion crow feeding on a drowned sheep which it has found washed to the bank of a river, and (right) a carrion crow being fed in captivity. This was the first of its species ever to be seen in a zoological collection and was obtained because a nest was blown down in a gale



Arthur Brook

BUZZARD AND KESTREL FEEDING THEIR YOUNG IN THE NEST

Both these photographs were obtained in Scotland where there is still much really wild territory where Nature is little interfered with. The lower photograph shows a buzzard and her young in the nest while above is a kestrel or windhover, as it is also sometimes called. The first is regaling its offspring with a couple of moles which it has caught while the kestrel has secured a rat. The young have to strive as best they can amongst each other for "first come first served" is the rule in Nature, and especially in a nest full of young birds.



Oliver G. Pike

C. W. Teager

C. W. Teager

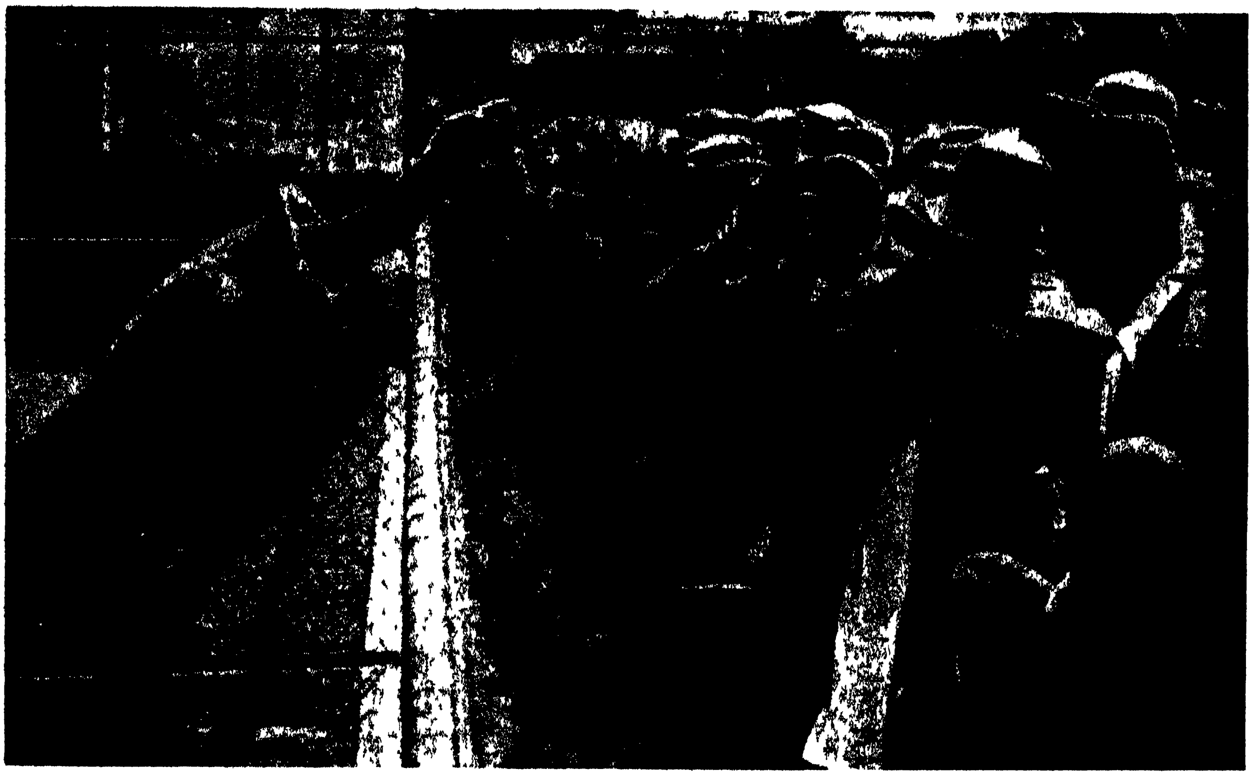
BRITISH BIRDS FIGHT FOR FOOD IN WINTER AND ROUGH WEATHER

When the snow covers the ground the birds of our gardens and countryside have a hard time, and the survival of the fittest—both as regards health and efficiency at food-finding—is the rule. At such times, when worms and grubs are buried many inches out of reach, the bird has learned that the homes of man may be productive of life-saving victuals. Above we have (bottom) a company of hungry chaffinches and sparrows in a garden ; (top left) a thrush that has found a likely garden ; and (top right) a song-thrush with a discarded apple.

The otter, for example, that notable destroyer of fish, is really a large weasel specialised for an aquatic existence ; and much the same is true of the fur-bearing minks, native to Europe, Siberia, and North America, though these also prey on small mammals and birds. Many birds also seek living prey in fresh water, and of this the fish-eating herons and kingfishers are well-known examples. Ducks and swans are more modest in their requirements, and their broad bills are used as strainers by which worms and other small creatures are separated from the mud in which they dwell.

Reptiles are well represented among the hunters in fresh water, and of these the most formidable are crocodiles and alligators, which not only devour aquatic animals, but also forage along the banks in pursuit of mammals and birds. The gavial of the Ganges possesses a long, narrow snout forming an effective fish-trap. The large, snapping turtles, native to the fresh waters of North and Central America, are savage animals which seize fishes and water fowl with their strong hooked beaks. Some of the large rapacious lizards known as monitors are also quite at home in the water, and of these the largest, *Varanus salvator*, which attains a length of seven feet, is native to South Asia and the adjacent islands, also ranging into Australia. Many snakes are also good swimmers, and the common grass snake may often be seen pursuing frogs in ponds.

Some of the fresh-water fishes are tireless hunters of their feebler brethren ; none more so than the pike, detested by the fly-fisher, but himself providing

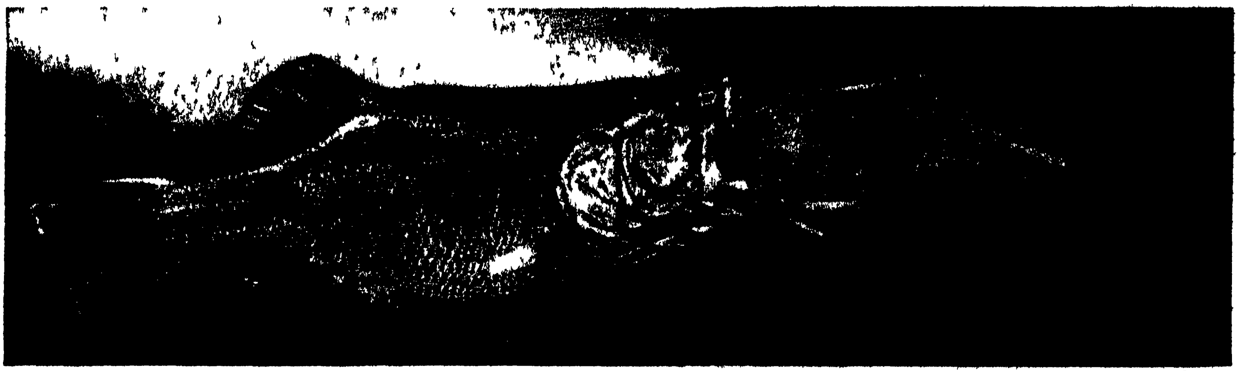


Central News

Alfieri

GIANT TORTOISE, HUNGER, A STUPENDOUS EFFORT—AND THEN DISASTER

Even the giant tortoises are not remarkable for their activity nor are they suited to violent efforts. A little tragi-comedy was enacted at the London Zoo by one of these clumsy creatures. Emboldened by the desire for food it heaved itself up as we see in the upper photograph, so that its head was above the railing of its paddock. But the effort upset the tortoise in more senses than one (bottom), and when on its back there was no hope for it until a keeper came and turned it over. Otherwise the tortoise would be on its back still.



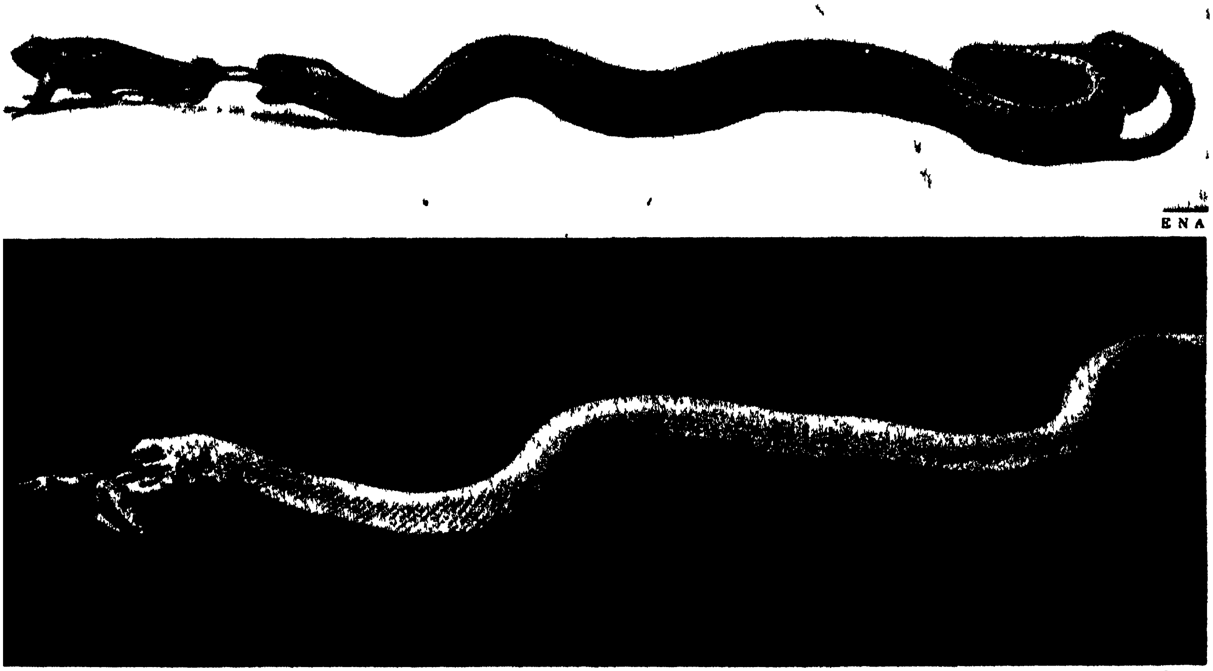
E.N.A.

AN ILL-JUDGED ATTACK IN THE FIGHT FOR FOOD

At its worst, the driving of hunger is the most unreasoning force in the world Fish, not very high up in the scale of animals that possess any intelligence, are notoriously rash when hungry Our photograph shows a couple of black bass that fell, one an innocent and one a guilty victim to unreasoning greed. The larger ran at the smaller and got the head well into its jaws and then found that it could neither swallow nor let go The two were picked up, still struggling, in a Texas lake. Pike will also try to swallow fish too large for their throats.

exciting sport. He may attain a weight of sixty pounds, is a notorious cannibal, and varies his diet with water voles, frogs, and water fowl. Size, however, is no criterion of rapacity, and some of the smallest species are extremely voracious. A particularly interesting case is that of the West Indian "millions" fish, which preys upon all sorts of little animals and is particularly fond of the wriggling aquatic larvae of mosquitoes. This is probably the reason for the immunity from malarial diseases enjoyed by Barbados.

An ordinary pond, in spite of its tranquil appearance, is the scene of many small tragedies. Its inhabitants include rapacious water beetles and other insect forms of still more bloodthirsty character. Conspicuous among these are the aquatic larvae of dragon-flies, provided with a curious apparatus jointed like one of the old-fashioned extensible carriage-steps, and placed below the mouth. When not in use, this "mask" is folded up over the face, but it is in reality a seizing organ that can be rapidly extended. Any small creature

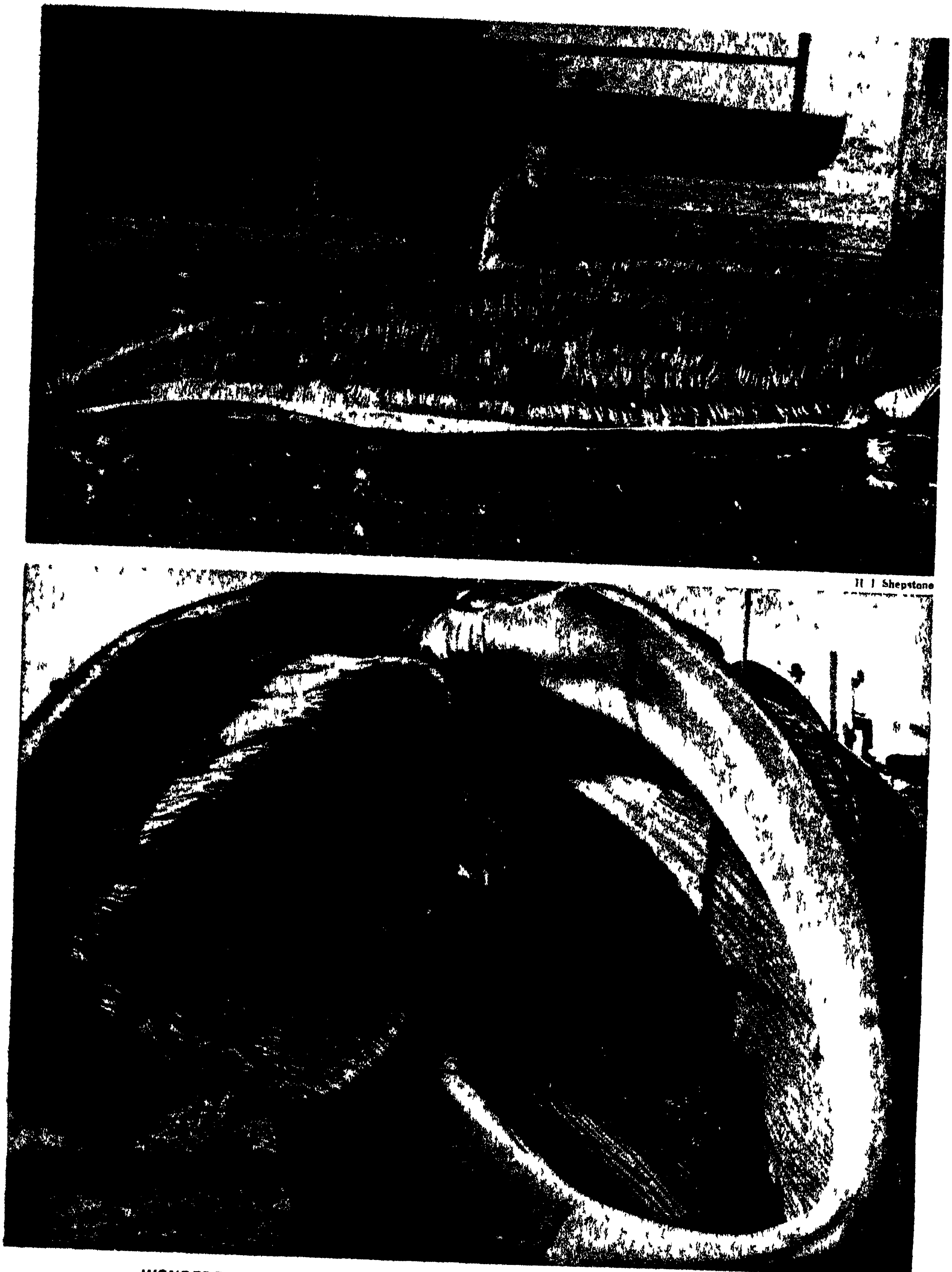


E N A

James

BY DEGREES THE SNAKE SLOWLY SWALLOWS A LIVING MEAL

When a snake decides to feed, its method is to have one good meal and then lie dormant for a time. Grass snakes may go some weeks between meals In dealing with a frog or a toad the snake seizes its prey by one leg and proceeds to swallow steadily, the victim pulling the other way and protesting as violently as it possibly can. Slowly the meal is engulfed and swallowed despite violent struggles, which do not seem to worry the snake at all, for it proceeds stolidly with its business until the end

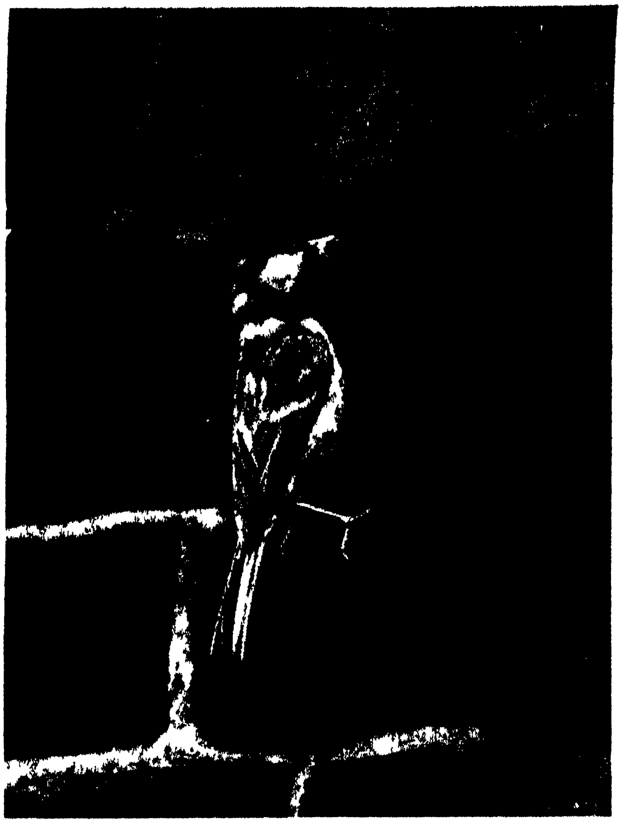


H J Shepstone

E N A.

WONDERFUL BALEEN THAT FORMS A FILTER FOR A WHALE'S FOOD

It is impressive to remember that the whale, the largest of the mammals, feeds on tiny fish and marine organisms. The system of filtration by which the baleen whales extract food from the water is made possible by the plates of whalebone or baleen. These are formed from the mucous membrane of the palate and comprise a great number of horny plates suspended from the roof of the mouth, and covered on their inner edges with bristles Here we have some baleen (top) and (bottom) a whale's mouth



F Vear

H Wallace

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WOODPECKER AND ITS NUTCRACKER: GREAT TIT AND MISSEL THRUSH

The two lower photographs give us an instructive insight into the habits of the woodpecker. On the left we see a bird peeping out cautiously from the hole it has drilled in a tree trunk for its nest and on the right a crack in the bole of a tree which has been ingeniously used as a nutcracker. Nuts have been placed firmly in the slit and the bird has then hammered them with its beak till they split. Above we have (top left) a great tit and (top right) a missel thrush both with good beakfuls of food.

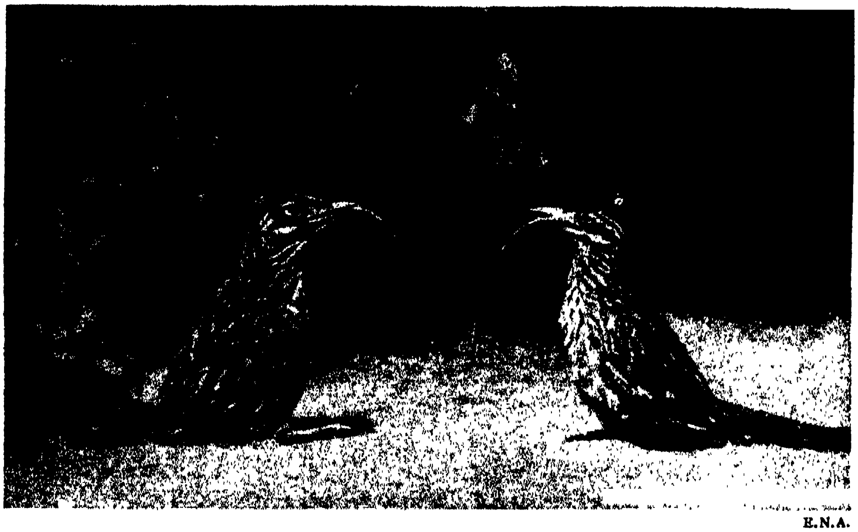
F. Vear

can be grasped by a pair of toothed pincers situated at the end of this structure, and is then drawn back to be dealt with by a pair of powerful jaws.

The flattened bug known as a "water scorpion" is also a hunter of note, with piercing and sucking mouth parts. The front legs are turned forwards and used for seizing or holding on to living prey, among which tadpoles and small fishes are numbered.

Of great interest is the hydra, or fresh-water polyp, a living tubular stomach about one-sixth of an inch long, of which one end adheres to a firm surface. The mouth is in the centre of the free end, and from it radiate slender tentacles studded with microscopic structures known as "nettling cells," from which poisonous threads can be shot out. Woe to any little crustacean, such as a "water flea," touched by any of these, for it is at once paralysed, drawn to the mouth, and swallowed.

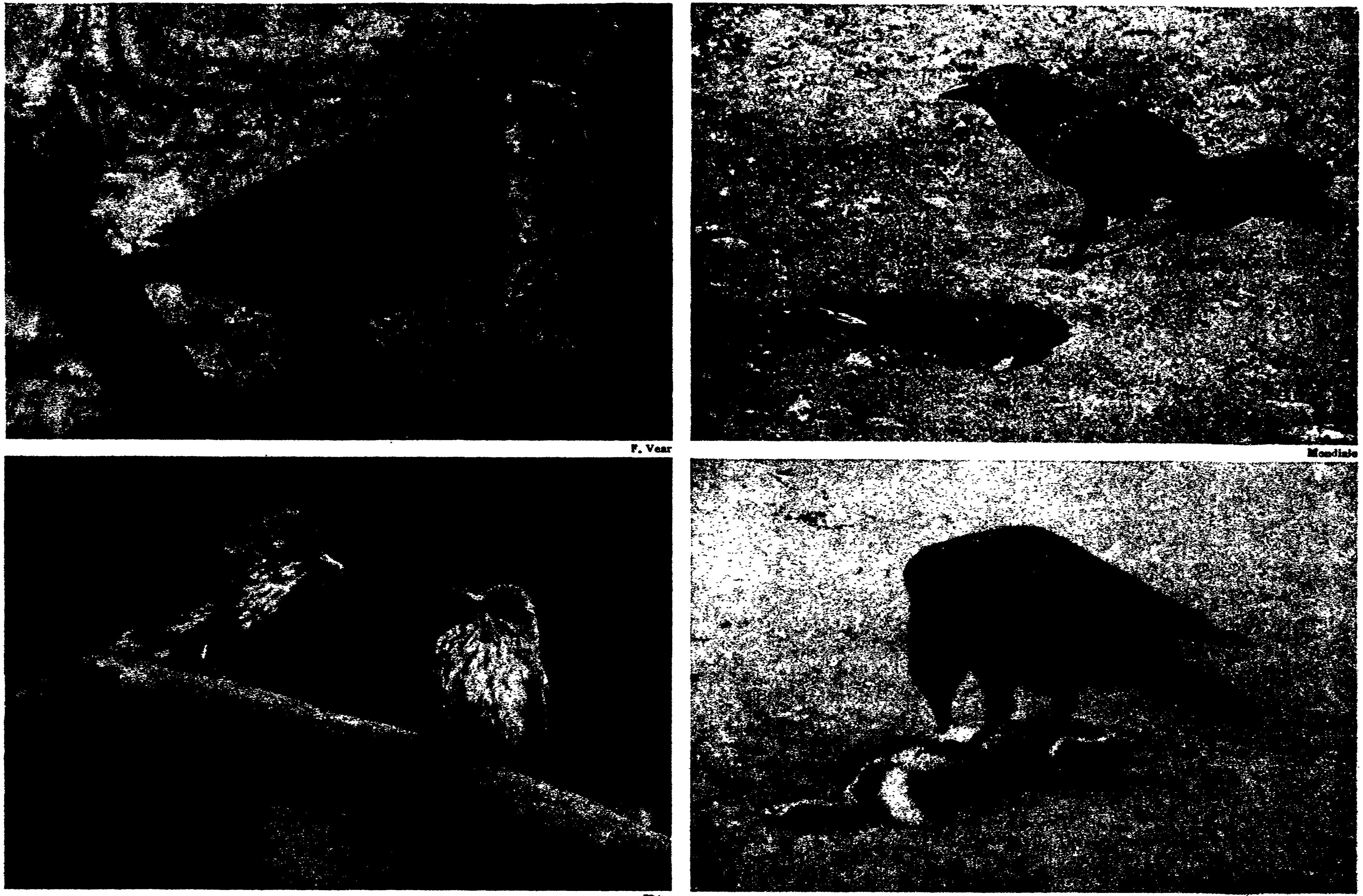
The sea is undoubtedly the original home of life, from which some groups of animals migrated to achieve the conquest of the land. Now and again there has been a return to this ancient abode, and a gradual re-adaptation to an aquatic existence. The sea lions, for example, notable hunters of fish, are distant relatives of bears in which the extremities have been converted into paddles, though the hind



E.N.A.

EXHIBITION OF LIZARD-SWALLOWING: CHAFFINCH'S NURSERY MEAL

Here is a remarkable photograph (bottom) from America. It shows two young road-runners, each of which has swallowed a lizard about a foot long and is now engaged in the lengthy process of swallowing. Notice that the birds have squatted back on their hocks and raised their beaks in the effort to get their meal down. Above is a cock chaffinch feeding its young.



F. Vear

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HUNGRY BIRDS FEEDING OR BEING FED: FLY-CATCHER, RAVEN AND BLACKBIRD

In the bottom left-hand illustration we see a spotted fly-catcher, the male of the pair, feeding the hen. The individual struggle for existence becomes a joint one when the sexes mate, and private hunger is secondary to the needs of the new generation. The fly-catchers may be known by their habit of selecting a perch on gate or fence and making little erratic flights back and forth after insects and returning to the perch. The fly-catcher likes insects, but the rare raven (bottom and top right) likes stronger food. Here we see one with a young rabbit it has killed. Lastly, we have a cock blackbird (top left), the father of a family, returned home with a good supply for everyone

E N A

ones can be bent forwards and used for a sort of clumsy progression on land. The true seals have gone a step further, for their hind flippers are turned backwards and united with the stumpy tail by folds of skin. Seals, though mostly marine, are also to be found in the Caspian, the Sea of Aral, and Lake Baikal, inland sheets of water which were once connected with the Arctic Ocean. Walruses are also marine carnivora, distinguished by the possession of huge upper tusks employed for digging up bivalve molluscs as food. The Cetacea (whales, dolphins, porpoises, and so on) are also descended from land mammals, and subsist on various kinds of animal food. The hind-limbs have been suppressed, the fore-limbs converted into paddles, and the tail spread out into a horizontal fin. Some are toothed, such as the porpoise, which devours large quantities of fish, often being a great nuisance to fishermen, and the dolphins are related forms, some of which have migrated up the estuaries of certain rivers of India and South America, to adopt a fresh-water life.

J. J Ward

DESTRUCTION OF APHIDES AND FLIES

Rose growers should feel very affectionately towards ladybirds. The lower photograph is of a ladybird larva devouring a green fly, while another green fly walks unconcernedly over its back. Above is a coleopter beetle killing a fly

There are also toothless Cetacea, such as the Greenland whale, which are curiously specialised for feeding on the shoals of small or minute creatures (plankton) of which vast numbers float in the surface layers of the sea. Numerous fringed horny plates (whalebone) hang down from the roof of the mouth to serve as a strainer. The whale, with open mouth, swims close to the surface, and swallows the little floating animals that stick to these fringes. There is no danger of suffocation, for the top of the windpipe is drawn out into a sort of cone that fits into the back of the nasal passages.

There are many birds that make the sea their home, and subsist on a fish diet, among these being gulls, cormorants, puffins, and divers. Most of these have retained the power of flight, but in the penguins the wings have been converted into effective paddles, enabling their owners, with the aid of powerful webbed feet, to surpass fishes themselves in their native element.

Marine carnivorous reptiles are relatively uncommon, though at an earlier geological period certain groups, now extinct, were the terrors of the sea. Although the " great sea serpent " appears to be fabulous, a few sea snakes are to be found in the Indian and Pacific Oceans. They are poisonous and prey upon fishes. The hawksbill turtle, the scales of which are the source of " tortoiseshell," are also flesh-eaters, their food consisting of fishes and molluscs.

The immensely numerous fishes which swarm in all parts of the ocean include a large number of species which pursue living prey of the most varied kind, largely belonging to their own class. Sharks, and their smaller relatives the dogfishes, are notoriously predaceous, their favourite hunting ground being the sea floor. Their tails are unsymmetrical, with a larger upper lobe, as a result of which unsteered swimming takes them downwards in a slanting direction. Large sharks often attain a length of from twelve to fifteen feet, but this may be greatly exceeded in certain species. The gigantic basking shark, for example, may be more than fifty feet long One of the most remarkable fishes of this group is the much-feared hammerhead, in which the eyes are borne on lateral projections. The comparatively small Port Jackson shark has most of its teeth converted into crushing plates well suited for dealing with shell-fish. The thresher shark, with a greatly elongated tail, pursues tactics of its own, swimming round shoals of such fishes as herrings, and by splashing with its tail causes these helpless victims to huddle together instead of trying to escape.

The highly carnivorous rays or skates are modifications of the shark type, in which the body is flattened from above downwards, and there is a long narrow

THE REWARDS OF GOOD HUNTING

C. W Teager

There is plenty of food in the summer when the birds are hunting for supplies to bring home to their nests. It is just a question whether or no they can see their family safely launched before they themselves become food for the hawk Here is a male blue tit feeding its mate, who is too occupied with the nest to go far to find food.

tail. Certain species native to the Indian Ocean may be as much as eighteen feet broad, and weigh over half a ton. The sting rays can inflict serious wounds by means of poison spines on their whip-like tails, while the electric rays have converted part of their muscular system into batteries capable of giving severe shocks.

The vast majority of fishes now existing belong to the bony type, having well ossified skeletons, with which many of the edible forms, herrings in particular, have made us painfully familiar. They are for the most part flesh-eaters, living on a great variety of prey, which they secure in many interesting ways. In such a fish the tail fin is usually forked and symmetrical, as may be seen in a mackerel, so that unsteered swimming is "right ahead." Many rely on speed for the pursuit and capture of living prey, as in the case of the albicore and bonito, forms of about six feet in length closely related to the tunny, which chase flying-fishes.

SOME lie in wait for their victims, a well-known example being afforded by the sea angler, which remains almost buried in the sand, and relies on its "lure," a rod-like back-fin with a waving membrane at its end, to excite the curiosity of its smaller kindred. When these approach sufficiently near the angler makes a sudden snap, and they disappear in his enormous mouth, escape being prevented by numerous rows of backwardly directed pointed teeth, hinged at their bases.

The deepest abysses of the ocean are tenanted by a variety of weird-looking fishes of extreme rapacity, which prey on one another and also victimise deep-sea crustaceans and the like. This would result in wholesale and rapid extermination, were it not that the bill of fare includes sundry items that sink from above or are washed in from the adjoining shallower waters. No ray of sunlight can penetrate to the "abyss," and these nightmare fishes are either blind or provided with enormous goggle eyes, for which light is furnished by phosphorescent organs studding various regions of the body.

The familiar flat fishes, such as turbot, sole, and plaice, are quite different in structure from the rays and skates, for instead of being flattened from above downwards they are laterally compressed. For some time after hatching they swim about in the usual way, but then begin to tip over laterally, either to the right, as in the turbot, or to the left, as in sole and plaice, and very soon sink down to the sea floor, where they are destined to hunt for their living. Innumerable small creatures, many of them shrimp-like, float in shoals in the surface waters of the sea, providing abundant nutritious food for certain fishes. Among these the herring is prominent, and, like the whale, it possesses a straining apparatus for separating its minute prey from the water in which they float. The water, used for breathing purposes, flows out on either side through a series of narrow gill-slits, to bathe the scarlet comb-like gills and aerate the blood giving them their fine colour. But the shrimplets cannot get through the gill-slits, being prevented by numerous elastic fibres ("gill rakers") springing from their edges, and preventing the loss of a tasty meal.

The herring, in its turn, serves as food for many other forms, among which is the squid, a mollusc of the cuttlefish kind. This elongated creature can dart backwards through the water like an arrow by expelling water from its gill chamber, and possesses ten extensible seizing organs, two of which, known as tentacles, are much longer than the eight others called arms. Suckers are present on the thickened ends of the tentacles, and rows of them stud the arms. Once grasped by these structures, the prey is drawn to the mouth and dealt with by a horny parrot-like beak, from which a curious rasping organ is protruded for scraping away skin and flesh. The squid has large staring eyes, can change colour rapidly to match its surroundings, and is able to conceal itself by ejecting an inky fluid.

Gigantic species of squid exist on the American side of the North Atlantic, and these sometimes reach a total length of over fifty feet, of which forty-two are accounted for by the tentacles. Bathers are sometimes attacked by these formidable creatures.

Chapter CV

The Wonderful Little Earwig

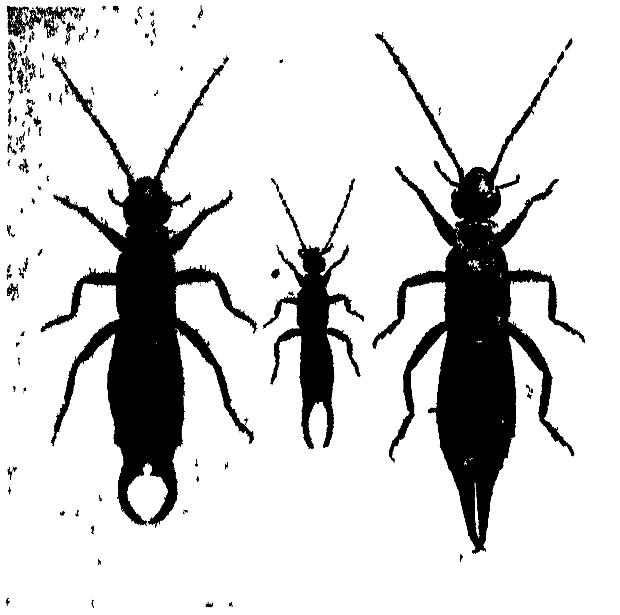
By John J. Ward

Author of "Insect Biographies"

There are few people who can really appreciate an earwig. Superstition and lack of accurate knowledge have done their worst to produce an abiding aversion to that much-maligned insect; whose greatest crime, so far as I am able to ascertain, is that it has an annoying way of suddenly falling from flowers and garden produce, and causing a scare as " a horrid earwig." Why it is " horrid " is difficult to understand, since it does not bite, sting, or commit personal injury of any kind. Furthermore, there is not the slightest foundation for the widespread myth that it will penetrate the human ear. It would, surely, be a very unbalanced earwig that would seek an adventure of that kind.

I have reared the earwig from the egg stage to maturity, and photographed every phase in its metamorphosis. I have gone further and followed its development until the end of the third generation; and I am here able to state that, if ever a friendly and almost entirely inoffensive insect has been sadly misunderstood, that insect is the common earwig.

The gardener will tell you about earwigs; he will show you the damage they have done to the petals of his dahlias, phloxes, carnations, violas, and what not; he will bring you the ripest apricot, plum, or pear, and show you the holes they have made; and, should you doubt his word, he may even shake some of them from the holes in the fruit while he informs you that " Seeing is believing."



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COMMON AND LESSER EARWIGS

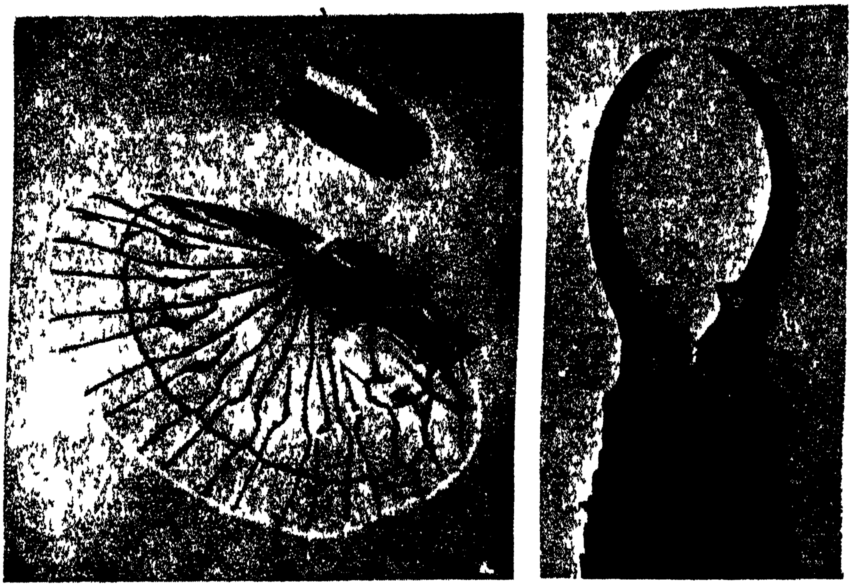
Of the three insects shown in this photograph the central one is a female of the lesser earwig while the other two are male (left) and female (right) of the common earwig. Notice the distinct difference in the forceps or hind pincers in each case.

In a corner of my garden there is part of an old wooden post with a coil of rope round it, and when I want an earwig specimen I can generally obtain one by uncoiling a strand or two of that rope. Nevertheless, I do not charge the earwig with attacking the post, or the rope. So it is with the earwig in the fruit. I know quite well that the hole in the fruit was first made by wasps, and that the earwig, being of nocturnal habits, has simply found in the hole a cool and sheltered resting-place in which to hide during the hours of sunlight.

At the same time, I am fully aware that the earwig will sometimes sip up some of the ripe juices of the damaged fruit; but really it sleeps away the greater part of the day, and its activities and real feeding do not commence until after darkness has set in. The truth is, the earwig is really a carnivorous creature, and its vegetable diet is insignificant, and probably eaten largely to quench its thirst.

In the same manner that the earwig hides in the damaged fruit, it will more or less disappear into one of the curled petals in a dahlia flower-head, and there remain motionless throughout the day. Perhaps that same flower-head may have some badly damaged petals, eaten almost entirely by night-feeding moth caterpillars, which are hiding on or near the ground during the day; but as the earwig is found there, it is saddled with the whole of the damage.

It is unfortunate that British gardeners rarely possess entomological knowledge. Their acquaintance with insects is mainly confined to attacking them with insecticides in order to kill them. They fail to appreciate the fact that many insects are their best friends, and much better destroyers of some of their worst pests than they themselves can ever hope to be. If the gardener better understood the ways and habits of the earwig, he would adopt an entirely different attitude towards it. The late Fred Enoch, who was a most skilled and careful entomological worker, says: " I have often, when preparing an earwig for microscopic examination, found its viscera full of the remains of hundreds of greenflies." To which may be added the fact that earwigs also feed on thrips, scale insects, tiny caterpillars, and baby slugs and snails; but their greatest virtue is that of devouring innumerable eggs of moths and other injurious insects. I can personally testify, too, that a family of baby earwigs will even eat up a batch of the comparatively large eggs of their own species, shells and contents rapidly disappearing, when they get the opportunity , but that opportunity is rare, for, as we shall learn later, the mother earwig



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WING CASE, WING AND PINCERS OF COMMON EARWIG

In the left hand of these two photographs are the wing case (top) and the wing, of a common earwig When we compare the size of this beautiful wing with the case into which it has to be folded it is no wonder that, on the very rare occasions when the wings are used, the pincers (right) have to be employed in re-folding them. The pincers here are those of a male

carefully guards her eggs against the attacks of such night-feeding families, which often move about with their mother in charge

The earwig is first and foremost a scavenger, and after dark it becomes extremely active, rapidly moving over the stems and leaves of plants, occasionally stopping to lick up a splash of sugary fluid, or a few pollen grains scattered by the wind or by the numerous flower-feeding insects during the day. Such spots, if left, quickly provide a germinating area for a colony of bacteria, or microscopic moulds and fungi, all of which may result in injurious effects upon the plant and destroy its foliage. There is, too, a considerable amount of minute insect debris, such as cast skins, injured aphides, and dead insects, that accumulate on the leaves during the busy hours of sunlight, all of which the numerous earwigs eagerly search for as they forage about in small companies. It is while they are so occupied that they find insects' eggs adhering to the leaves and stems, and for these they have a particular relish Such is, undoubtedly, the real function of the earwig, and I make the statement after much careful observation over a period of several years.

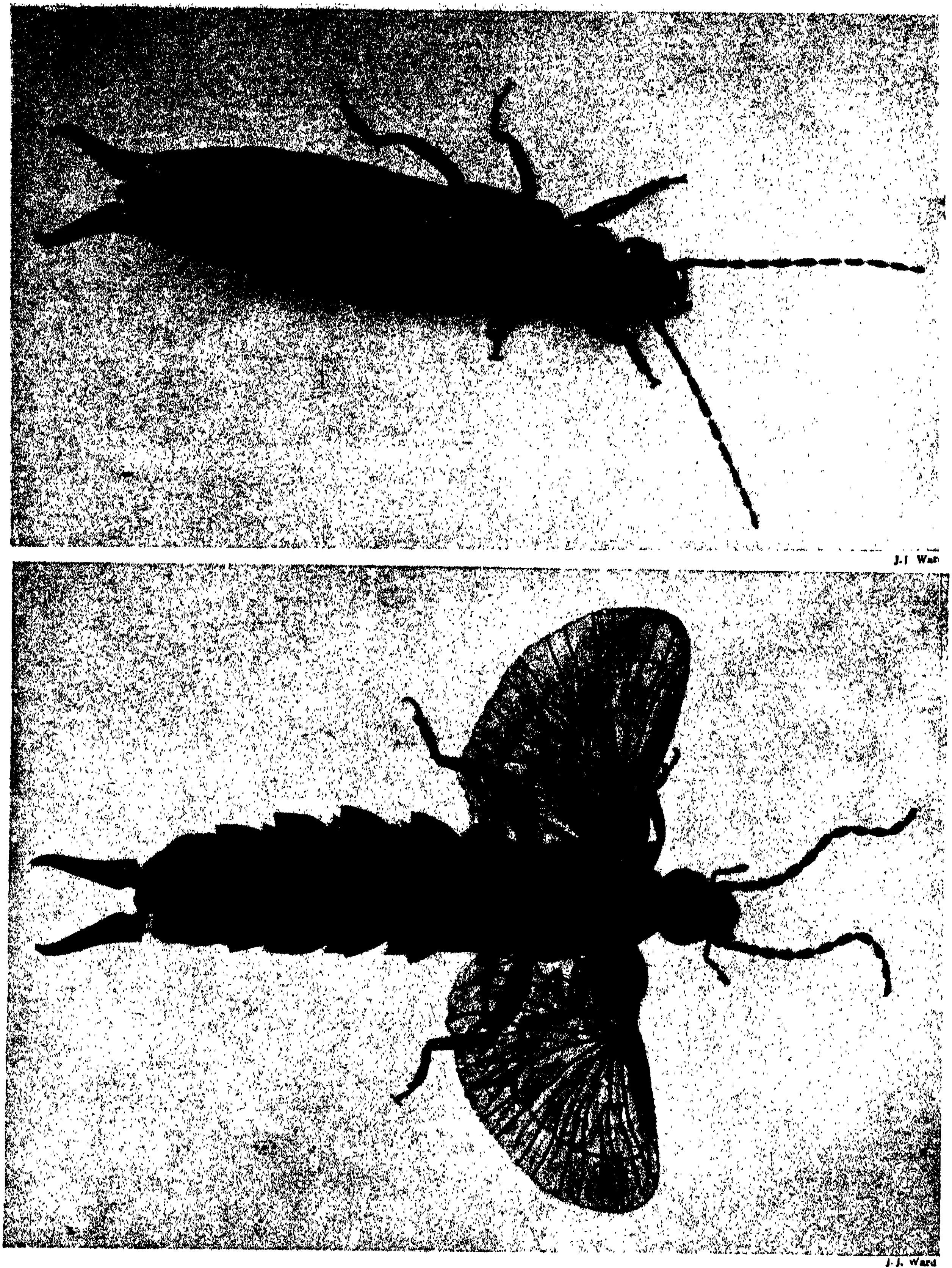
WE should remember, too, that the earwig is probably the most prolific insect to be found in gardens. The reason is obvious—it is because the scavenger is there most needed. The strong and hardy plants of the wild do not need the services of the sanitary inspector nearly so much ; and in a newly-laid-out garden where everything is clean and tidy, but few earwigs will be found. This work of cleaning up the leaves, stems, and flowers of plants may seem trivial, but, actually, it is of the greatest importance in keeping the plants in good health ; especially during long spells of dry and hot weather when there is no rain to wash the leaves—always when the earwig is most active.

So much then for the valuable scavenging work of the little earwig ; but, surely, a reader will contend, the earwig does feed on the petals of flowers ? The answer is, certainly it does, and, on occasion, almost as much on tender green leaves. It does not, however, prefer that food, and rarely ever selects it during the early months of the season ; but as the months advance earwigs multiply in great abundance, each mother earwig being able to rear three or four families of an average number of forty each from April to October. The young attain full growth in about eight weeks, and, as they can increase at the same rate, it follows that, as the summer advances hordes of earwigs appear in all suitable places.

So effectively do these hordes carry on their scavenging work, that sooner or later there is a shortage of their normal food supplies ; and it is then that they supplement them with a vegetable diet. We must not fail to note, however, that when ever the earwigs are injuring the flowers, it is then that the plant is most free from aphides and other pests. Every worker in the garden is worthy of his hire, and, surely, it is better to have a few damaged flowers than unhealthy plants with shrivelled leaves, and filthy with greenflies.

Also, let us always make sure that the earwig is the real culprit. I have carefully marked perfect ox-eye daisies, phloxes, chrysanthemums, and other flowers early in the day, and those same flowers by evening have had their petals riddled with holes. I have watched in the bright sunlight tiny flies with biting mouthparts, together with tiny beetles, making those same holes ; but my gardener accuses the earwig of the whole of the damage. Furthermore, although earwigs will feed on over-ripe fruit, I have yet to meet the gardener who has ever seen an earwig break the skin of a sound plum, pear, apple, or other fruit. It certainly never does that.

Although one of the most familiar of British insects, yet its life-story has remained very inaccurately known. It is a charming and wonderful story with many quite unique features. As insects go, it is comparatively long-lived. Under normal circumstances it lives at least a complete year in the adult stage, and sometimes longer. Some of the females hibernate for the winter, but are not entirely dormant. They, like the queen wasp, are fertilised, and are

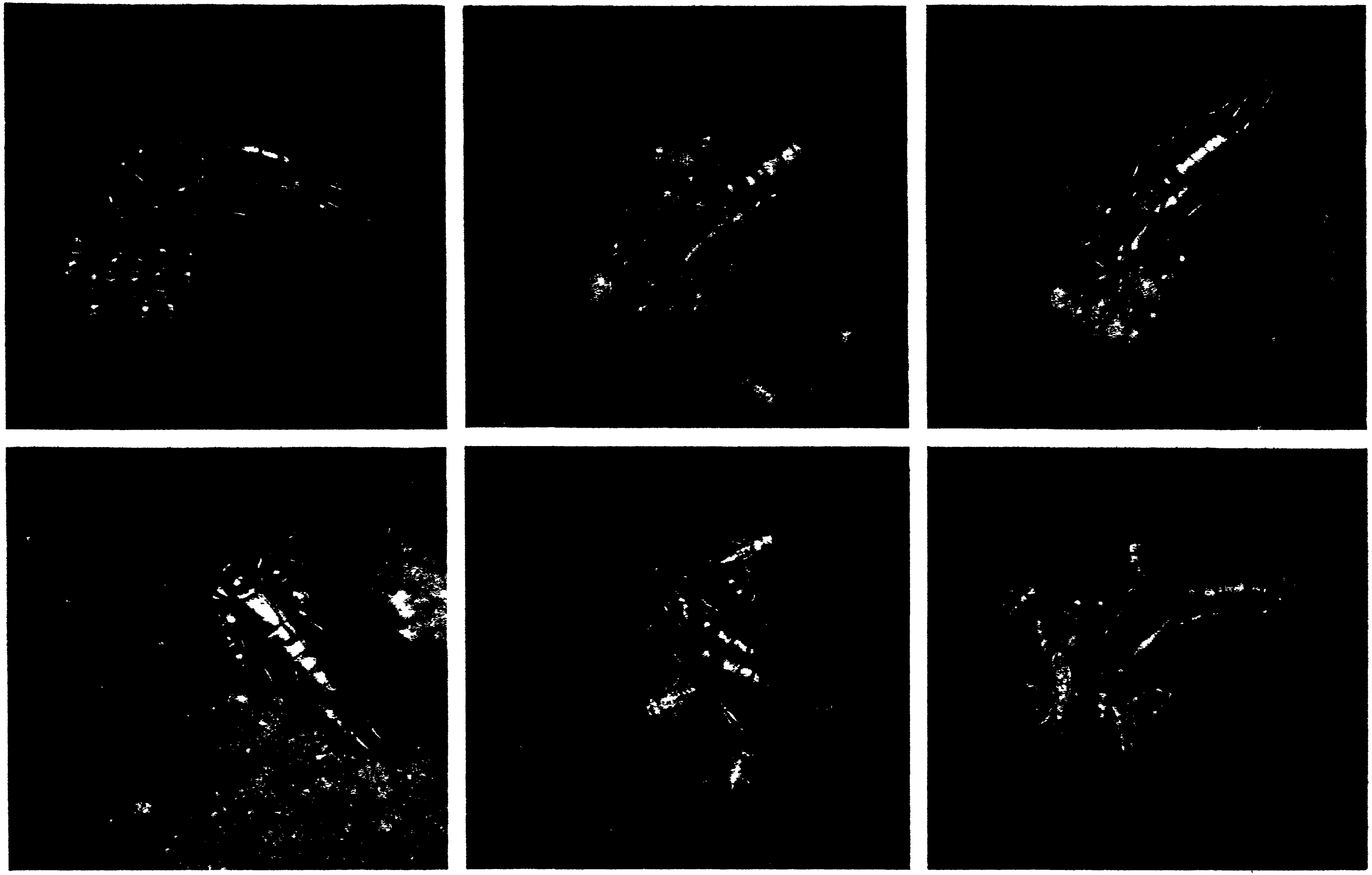


J. J War

J. J. Ward

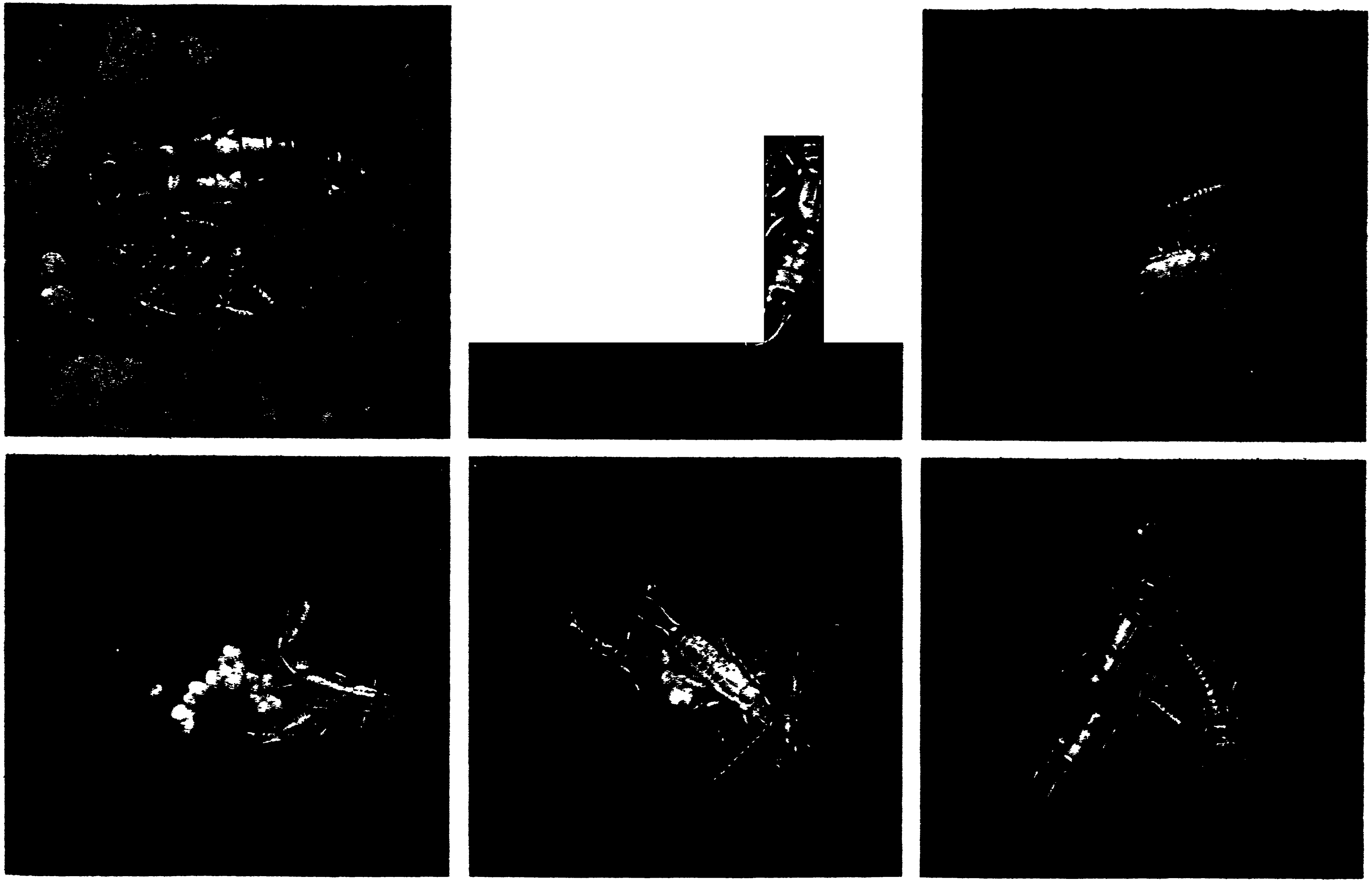
EARWIG AND ITS WONDERFUL AND RARELY USED WINGS

It is very rarely indeed that the common earwig opens its wing case and unfolds its wings. The lower photograph is of a common earwig displayed to show the opened wings. They are never used in flight, and not one in ten thousand individuals ever opens its wings at all. There are flying species of earwigs and also some without any wings at all, and it seems that the earwig is in a transition stage and is gradually evolving from a flying to a crawling life. The upper photograph shows an earwig with wings closed. Both illustrations are considerably enlarged



MUCH MALIGNED AND MISUNDERSTOOD INSECTS: THE HATCHING OF A BROOD OF EARWIGS

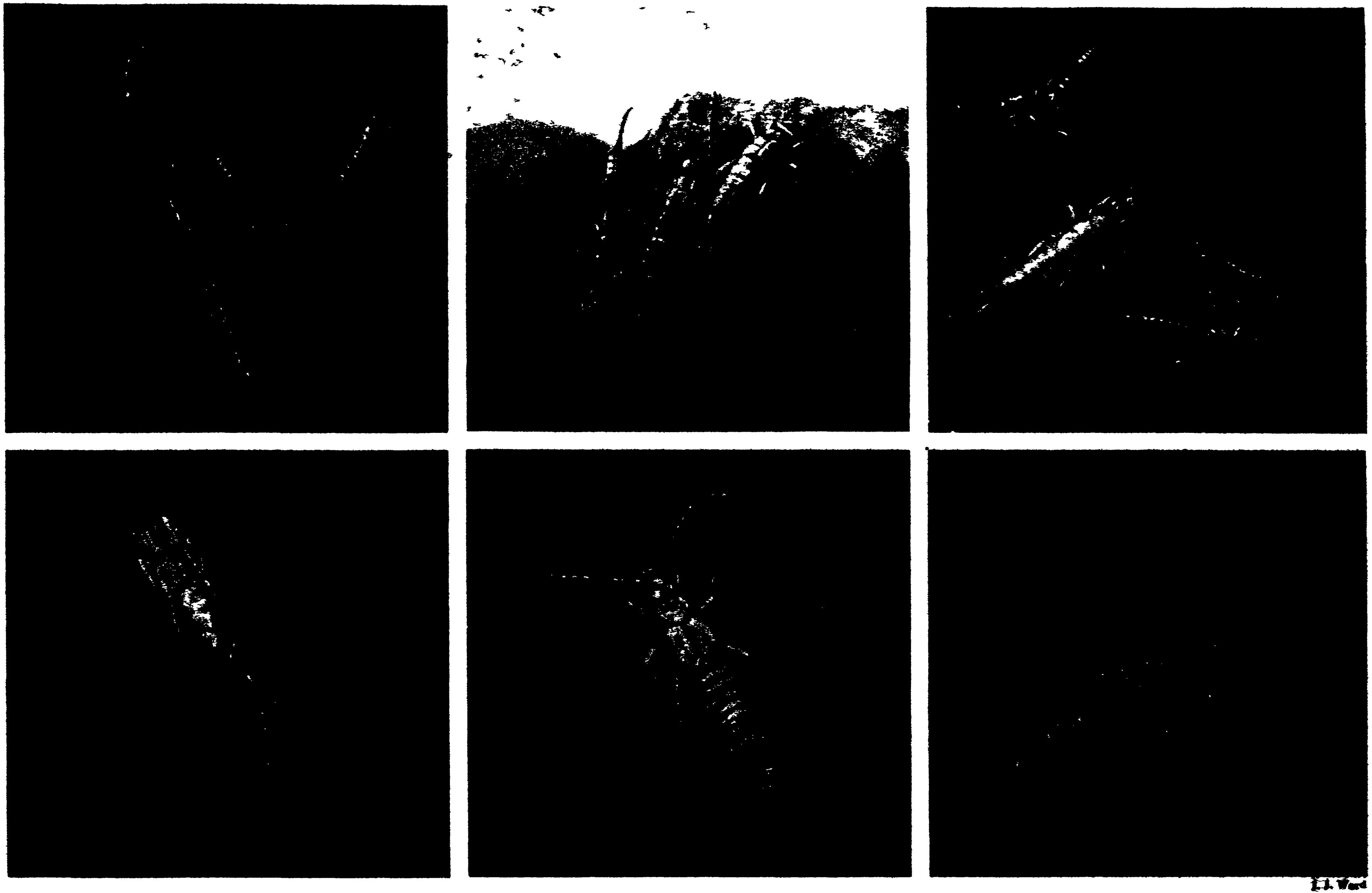
too often regarded with loathing and, at the best, can only expect indifference. Yet they are both extremely useful creatures and the e
to endear it at least to those who delight in gardens. This series of enlarged photographs, which should be studied from left to right be
it is practised among these curious and unjustly condemned insects. Having laid her eggs (top left) mother earwig sorts them with her man
broods over them until, after sixteen days or so the eggs hatch. This careful matron then helps her youngsters with the business of



J. J. Ward

MOTHER EARWIG, ARMED WITH "KNUCKLE-DUSTERS," GUARDS AND BRINGS UP TWO FAMILIES AT ONCE

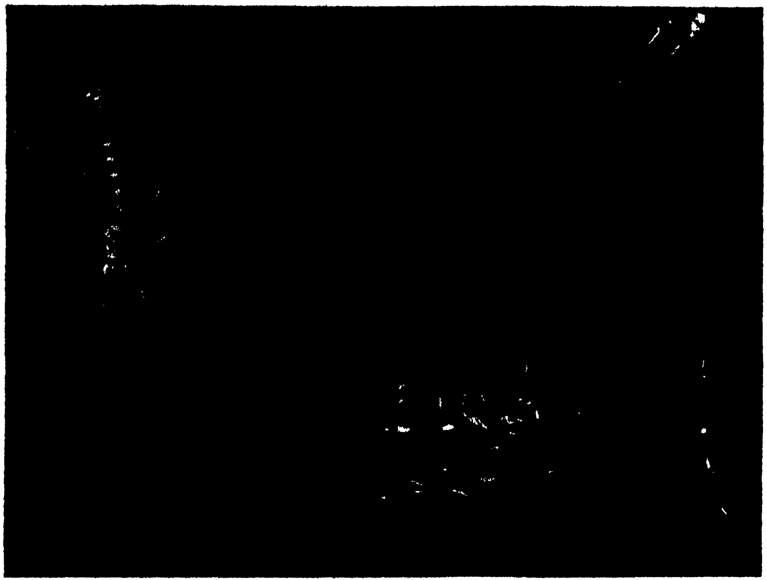
The remarkable tale of maternal solicitude, begun in the opposite page, is continued here. In about an hour the young are all free and the mother begins raking a hole in the soil (top left) into which her family of fifty or so immediately scuttle and begin to feed. The mother and her young are now half-buried (top centre) and she has now encased her hind pair of legs in lumps of mud. Any intruder she meets with a vicious sidelong kick, the mud lumps acting like knuckle-dusters in giving more power and effect to the blow. In two weeks the young moult for the first time (top right) emerging as white insects as they did on hatching The lower photographs show a second family born while the first is still being reared through successive moults.



J. J. Ward

ELABORATE MOULTING PROCESS OF A YOUNG EARWIG AS IT GRADUALLY GROWS TO MATURITY

As the young earwigs grow they burst a succession of skins, each time emerging as silvery white insects but rapidly becoming a neutral colour to harmonise with the soil. Here (top left) we have first a young earwig preparing for its third moult. The wing cases begin to appear at this stage and are present in the specimen nearest the lower edge of this photograph. Then the moult proceeds and the insect emerges from its old skin, and is larger than its brothers and sisters who have yet to moult. The bottom left-hand illustration shows the fourth moult being made on a dandelion leaf. Then we see the tail pincers being used to pull away the old skin until finally the insect appears, half as large again, in its new suit (bottom right).



J. J. Ward

AN EARWIG FAMILY THAT KEEPS TOGETHER

The top photograph shows the final scene in the moulting process of the earwig we considered in the opposite page. Having finished with its old skin it hurries back to join the family. The formation of the pincers proves it to be a male. The lower photograph shows some of the family hiding in the soil till night time comes.

awaiting their first opportunity to lay their first batch of eggs. Until early spring they hide beneath stones, and below ground; but at the end of April the mother earwig comes to the surface of the soil, and in a sheltered spot rakes out a hole in which she places some fifty or sixty eggs.

The large, pearly-hued eggs are broadly oval in form, and when seen under a magnifying lens are iridescent with rainbow colours. They occupy the whole attention of the mother earwig; and that is an extremely interesting point, for it is few insects indeed that give any attention to their eggs other than providing a store of food with them for their developing offspring, or depositing them on a particular food plant suitable to them.

Altogether different is the behaviour of the mother earwig with her eggs, for she never leaves them except when she has to seek food, and even then she constantly returns to see that they are safe. She does not sit on her eggs to hatch them, as we are told in many natural history works she does. What she really does is to place them well in the soil and cover them with her foreparts and first pair of legs; her body and second and third pairs of legs, and her tail pincers, projecting upwards and effectually blocking the entrance to the hole.

The function of the tail pincers has always been a natural history puzzle, their only suggested use appearing to be that of assisting in replacing the earwig's wings under their covers (for it has a wonderful pair of wings, of which more anon); but in view of the fact that there are wingless earwig species which are provided with more formidable tail pincers than those of the common earwig, that can scarcely be regarded as their true function. If, however, we observe the common earwig guarding its eggs just when the young are hatching out, we are able then, I think, to discover the import of these organs.

One earwig I had under observation with young appearing from her eggs, I gently touched with a quill toothpick. Instantly the tail pincers were turned towards the toothpick like a pair of fearsome jaws about to make a grip. A touch on the opposite side quickly brought them in that direction. Then, however, came a surprise. From out of the soil she suddenly jerked one of her hind legs with a savage side thrust, and the foot of that leg I found was encased in a hardened mass of dry mud—a kind of sledge-hammer "boxing-glove." The foot of the other hind leg was similarly covered.

Those actions surely suggest that the tail pincers, and the mud-covered hind feet, are means of protection for the eggs and young. That the hardened mud was purposely accumulated is certain, for two days later I noticed that she had lost one of the mud clumps, but the following day it had been replaced. Only the hind legs are so covered; the first and second pairs are needed for walking and raking up the soil. When she leaves her nest her mud-covered legs simply drag behind. When the young are about a week old, these mud clumps are completely disposed of.

The eggs hatch in fifteen or sixteen days, and during the incubation period the mother earwig is very active, continually re-arranging the order of the eggs, and not infrequently removing the whole batch to an entirely new burrow, which she first constructs for them. It is interesting to see her carry the eggs. They are slightly adhesive, and by taking hold of one in her mandibles she can often lift a dozen or more at a time, carrying them while held well up from the ground; when they look like a bunch of glistening, pearly balloons. Afterwards she returns and collects the scattered ones. This changing of their position is apparently to obtain the correct conditions of moisture and warmth for their incubation.

When the young are hatching out the mother earwig becomes very agitated, continually pushing her head and feelers in amongst them, and rendering every assistance for her babies to emerge. In about one hour she is surrounded by a crowd of fifty or more silvery white youngsters with jet-black eyes, all as active as a swarm of bees; for their mother is raking out a hole in the soil into which they run and commence to feed. What is the nature of their food at this stage is difficult to understand. It is probably bacteria and micro-organism, or particles of broken-down animal and vegetable matter. An hour after commencing to feed there is not a white baby earwig to be seen, every one has changed to the colour of the soil. It may be that earwigs serve some function in the soil like that of the earthworm, in reducing it to a friable state; or even in assisting to keep a natural balance in the bacterial colonies working below ground.

There is probably no insect in the world that possesses the maternal instinct in so large a degree as the common earwig. She leads her family about just as a hen does her chicks. At the slightest sign of danger, by means of a touch with her feelers, she brings her crowded family instantly to order, so that not one is moving in the burrow; probably the alarm is conveyed from one to the other. In any case, the action is very prompt, and they remain still until the "all clear" signal is given.

At two weeks old, the baby earwigs moult their skins, when they are again silvery-white, but almost immediately change to a dirty-grey colour. Their mother is then still actively assisting them in foraging for food. How long she would remain with them was a problem that needed solving. She and her eggs had been under my observation from April 23, and her family appeared on May 9, and when the young were half-grown, on June 3, I was confronted with a considerable surprise.

The mother earwig had laid another batch of eggs, thirty-eight in number. She was trying to hide them in the soil, but was much harassed by the members of her first family crowding round her, though she did not make any effort to drive them away. Two days later she was still tending her eggs and managing her half-grown family, some of which had once again become silvery-white, for they were moulting their second skins. It was then that I decided to remove her with her eggs to new quarters. Until that time she had been enclosed in a metal box filled with soil and covered with a glass lid, and no male earwig could possibly have found access to her. I was, therefore, desirous of testing if this second batch of eggs would prove fertile.

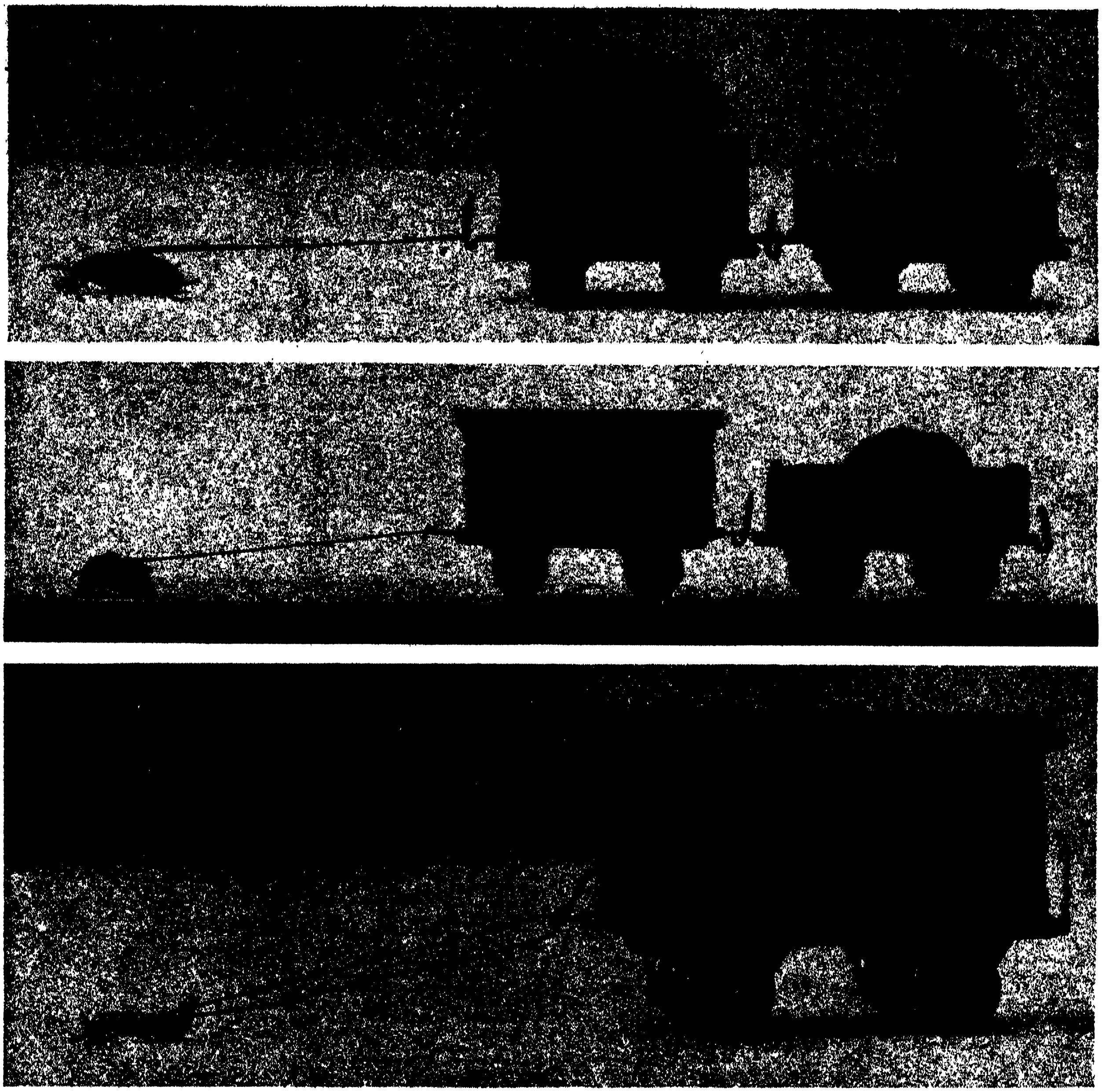
When I had prepared her new home, I found that all the eggs had disappeared excepting a few bits of broken shells. My arrangements for rearing the earwig family had been so perfect that I had not lost one of them, but I had failed to provide the young with an important item in their menu—that of insects' eggs. The now thriving family had made good that item, and devoured the whole batch of eggs their mother was tending; and, since they were her own offspring, instinct had not guided her to drive them off.

Twenty-two days later, that is, on June 25, the mother earwig, then isolated from her first family, deposited a third batch of eggs—but this time only twenty-six. On July 9 she showed considerable excitement over this new batch. Was instinct guiding her correctly? Would those eggs prove fertile? The following day she was rearing her new family. There is nothing particularly wonderful in these apparently unfertilised eggs hatching out young, for this phenomenon of parthenogenesis is familiar in the case of many insect species. Probably the mother earwig was fertilised the previous autumn, before her hibernation, and that holds good for all her eggs—as in the case of a queen wasp.

There is probably no other insect known that rears three or four broods of young in one season, tending each family until its individuals are able to fend for themselves. Regarding the feeding of these families, I found that they consumed almost every kind of decaying matter likely to be found in the soil, both animal and vegetable, and preferably in a sodden state. Decaying, over-ripe apples, and other fruits, together with bits of injured earthworms and dead insects, were much favoured feasts; but dahlia blooms I provided them with were never touched, although dandelion leaves enclosed with them were eaten to shreds.

On the same day that the mother earwig's new family appeared, the offspring of her first family were making the fourth and final moulting of their skins, appearing as snowy-white mature earwigs with conspicuous black eyes; but changing within an hour to the glossy brown colour with which we are familiar. It should be noted that there is no complete metamorphosis of larva, dormant pupa, and adult stages; the young earwig remains active throughout its development, its wing-cases appearing just before its third moulting, and its wings with the final stage.

The earwig's wings are rarely seen, because not one earwig in a hundred thousand ever expands its wings throughout its life period.



J. J. Ward

INSECT FEATS OF STRENGTH, AND THE GREATEST IS THE EARWIG'S

These astonishing photographs make wonderful revelations as to the strength of insects. The earwig is the Goliath of them all. From top to bottom the illustrations show: a ground beetle with a load of plasticene 182 times its own weight; a bumble bee with 300 times its weight; and an earwig (bottom but one) moving 530 times its own weight. In the last photograph we have our earwig dragging a dead weight of pins 27 times its own weight. In the other cases the load is on wheels and more easily moved than a dead weight dragged with much friction.

W. S. Berridge

FOUR ANIMALS WHOSE TOTAL EXTINCTION IS ONLY A MATTER OF TIME

So far as extinction is concerned, every race of animal, man included, has to fight against the danger of it and, in Nature, there is no mercy for the unfit. Many races of animals became extinct through one cause or another—change of climate, inroads of the sea, increase of old enemies or influx of new ones—long before man appeared on the earth. Since human beings became the dominant race of life, certain animals have, of necessity, come into conflict with them and been wiped out. The Tasmanian devil (bottom left) has been greatly reduced in numbers owing to its damage to flocks. The bush-dog (bottom right) of Brazil, the paca rana (top left) exhibited for the first time at the London Zoo in 1925, and the chinchilla (top right) are all disappearing.

Chapter CVI

Recently Extinct and Disappearing Animal Types

By W. T. Calman

Keeper of Zoology, British Museum

GEOLOGY has made us familiar with the fact that animals of innumerable kinds which once lived on the earth died out, leaving none to represent their race in the land of the living. It is a matter of common knowledge that the same sad story is being continued in our own time, and that many kinds of animals now living are doomed to early extinction. There is, however, a good deal of misconception as to the way in which this extermination has come about.

We commonly hear it said that a certain species has been "killed off" by man, or that it has disappeared before the advance of civilization. No doubt in very many cases one or other of these explanations is the right one, but there are many instances where man has been only indirectly and remotely responsible for the death of the species, and some in which savage man has been no less efficient in destruction than his civilized brother. There is evidence also that certain species, for the destruction of which man has been held responsible, were already on the down grade, and that human intervention has, at most, only hastened an end that was already in sight.

Most people, if asked to name an animal exterminated by man, would perhaps think first of the dodo. When the Portuguese discovered the island of Mauritius in 1507, they found on it numbers of this great, grotesquely clumsy ground-pigeon, unable to fly, and allowing itself to be knocked on the head with a facility which led them to call it "doudo," or "stupid." After the Dutch took possession of the island in 1598 we get more exact accounts of the bird and some individuals were brought alive to Europe. One at least was exhibited in London in 1638—to parody three lines of "Macbeth" by one word—

> . . . as our rarer monsters are,
> Painted upon a pole and underwrit,
> 'Here you may see the *dodo.*'

PERHAPS this was the specimen that afterwards came into the possession of John Tradescant, and so to the Ashmolean Museum at Oxford. The art of taxidermy, however, was little advanced in those days and in 1755 the specimen was in such bad condition that it was ordered to be destroyed, only the head and one foot being kept. Long before this, however, the last dodo had died. In 1681 we learn that none were to be found in Mauritius. It does not appear that they were intentionally killed in large numbers. The flesh was very hard and almost uneatable, only that of the breast being at all palatable. The Dutch called dodos *walgvögels*, "nasty birds." Their extermination was due chiefly to other animals introduced by man, pigs, rats and monkeys, which were quick to take advantage of such easy prey and devoured eggs and young.

The story of the great auk, or garefowl, is very different. Here, also, we have a flightless and defenceless bird, but one with a wider distribution, for these giant razorbills ranged over a great part of the North Atlantic, congregating to breed on certain rocky islets off the coasts of Newfoundland, Iceland, the Faroes, the Orkneys, and St. Kilda. When first we hear of it at the end of the sixteenth century, French fishermen on the Newfoundland coast were provisioning their boats with barrels of salted "penguins." Later, its eggs, skin, and feathers were sought after, and the birds were slaughtered in vast numbers and sometimes in circumstances of incredible brutality. Early in the nineteenth century the only remaining haunts of the species were two or three isolated rocks off the coast of Iceland. One of these, known as Geirfuglasker, "Garefowl Skerry," disappeared into the sea as the result of a volcanic convulsion, and, deplorably enough, about 1844 "the latest survivors were killed to supply caterers for the museums of Europe." In this instance, then, the evidence is conclusive that extermination has resulted directly from the ruthless persecution to which the garefowl was subjected.

BOTH the dodo and the great auk were exterminated, directly or indirectly, by civilized, or, at any rate, by European man, but there is no trustworthy evidence that the moas of New Zealand were ever seen alive by white men. They were gigantic birds of the ostrich tribe, some of them standing 12 ft. in height. When the Maoris reached the North Island of New Zealand, probably about 500 years ago, several kinds of moas seem to have been abundant and the Maoris hunted them for food. Within a century or so they were completely exterminated in the North Island, although in the South Island they seem to have lingered later, perhaps till the eighteenth or early in the nineteenth century.

As the story is commonly told, the moas are said to have been "killed off" by the Maoris, but there is reason for doubting whether this is actually what took place. It is certain from Maori tradition, and from the remains found at ancient native cooking-places, that the moa was a favourite article of food and in a country devoid of other large game the destruction may have been very great. It has been pointed out, however, that great quantities of moa bones have been found in very inaccessible localities on the

South Island, where there is no reason to believe that the Maoris ever penetrated. What caused the death of such large numbers we can only guess. It may have been epidemic disease or some climatic change; it can hardly have been the Maoris.

The three examples discussed above were birds whose inability to fly rendered them an easy prey. It is less easy to understand the extermination of a powerful flier like the passenger pigeon of North America. The bird was formerly plentiful over a great part of North America, ranging from Canada to the Southern States. Audubon and other naturalists of the early nineteenth century have given memorable accounts of the vast flocks in which it migrated. In 1874 it was still common, but a rapid decline set in and twenty years later it was only to be found near the northern border of the United States and in Canada. At the beginning of the present century it was extinct in the wild state and though a few individuals lived for a few years longer in captivity they have left no descendants to carry on the race. The causes of this sudden decline are very hard to guess at. The passenger pigeons were certainly killed in large numbers for food, but one gets the impression that the toll taken by man would not, of itself, have sufficed to make much impression on the multitudes, any more than the persecution which they suffered from predatory birds and other animals attracted by the migrating flocks.

In all parts of the globe the arrival of man has been followed by the retreat or extermination of the larger mammals. What share our prehistoric ancestors had in the extermination of the mammoth we cannot now determine, but in more recent times the continuance of the process can be clearly traced. In 1914 the last survivors of the bison, the largest wild animal remaining in Europe, were to be found in two localities, the forest of Bialowicz in Lithuania, and the forests of the Caucasus. As it happened these two regions were traversed and re-traversed by rival armies during the Great War, and at its close the European bison had ceased to exist in the wild state. Some two score individuals are still alive in zoological gardens and parks in various parts of Europe, but it is doubtful whether it will be possible to maintain or increase their number.

The history of the American bison (called the buffalo in America) is still more disastrous. The vast herds which covered the prairies of the Wild West are familiar to us from countless stories of adventure, but fact has not

OKAPI, A DISAPPEARING RELATIVE OF THE GIRAFFE

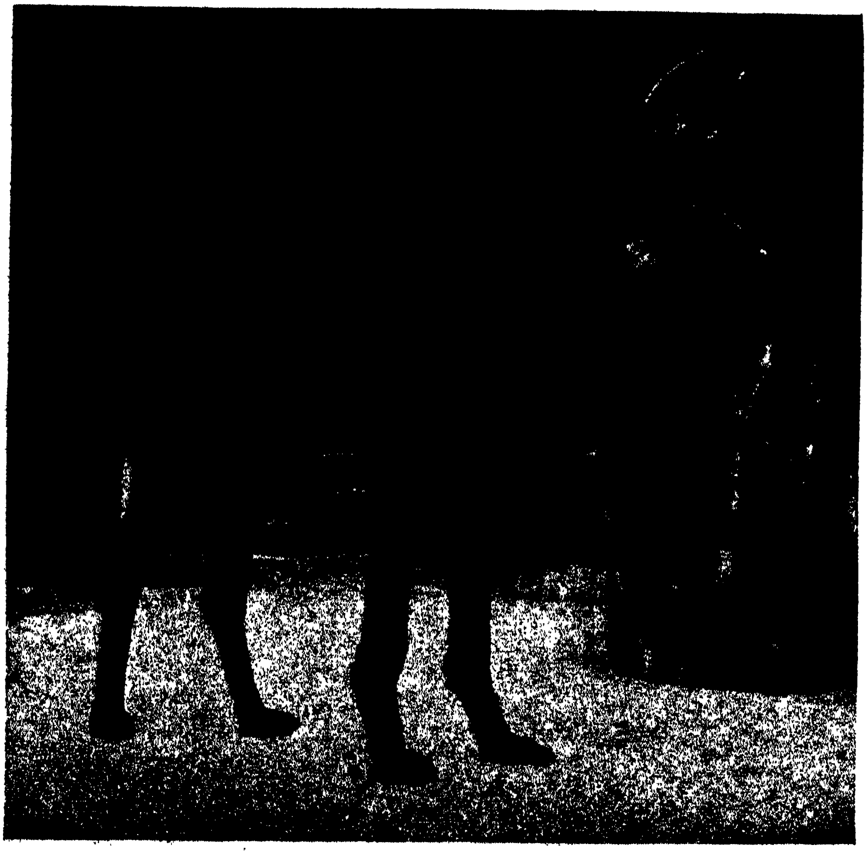
Related to the giraffe and the only near relative that animal now possesses, the okapi was discovered in 1901 although Stanley is said to have seen it previously. Only a few small herds are still left to-day in the very densest forests of Africa.

been outstripped by romance. As late as 1871 a traveller in Arkansas rode for 25 miles from east to west through a great herd of these animals on migration. "The whole country," the record says, "appeared one mass of buffalo moving slowly to the northward." From other accounts we know that this same herd extended some fifty miles from north to south and at a very moderate estimate it must have comprised some four million head. How many herds like this the continent held we have no means of guessing, but even at that time buffalo hunting was a trade and buffalo skins were important articles of commerce.

The completion of the trans-continental railway and the introduction of the breech-loading rifle inaugurated a period of great prosperity for the industry. No one seems to have recalled the fable of the goose with the golden eggs, and when bison began to be less plentiful there were complaints that this result was due to shooting expeditions of "English sportsmen."

The startling suddenness of the decline is illustrated by the records of buffalo hides consigned by a single railway, the Northern Pacific. In 1882 there were 200,000 hides; in 1883, 40,000; in 1884, 300, and in 1885 not one. By this time the chief industrial use made of the bison was the manufacture of fertiliser from the bleached skeletons which littered the prairies and which were collected in hundreds of tons to be ground up for this purpose. The last wild bison is said to have been killed in 1897, but a few small herds are preserved in the Yellowstone Park and other game preserves. A northern race of the bison, differing slightly from that of the great plains, still exists in Canada in the region of the Great Slave Lake and the Mackenzie River.

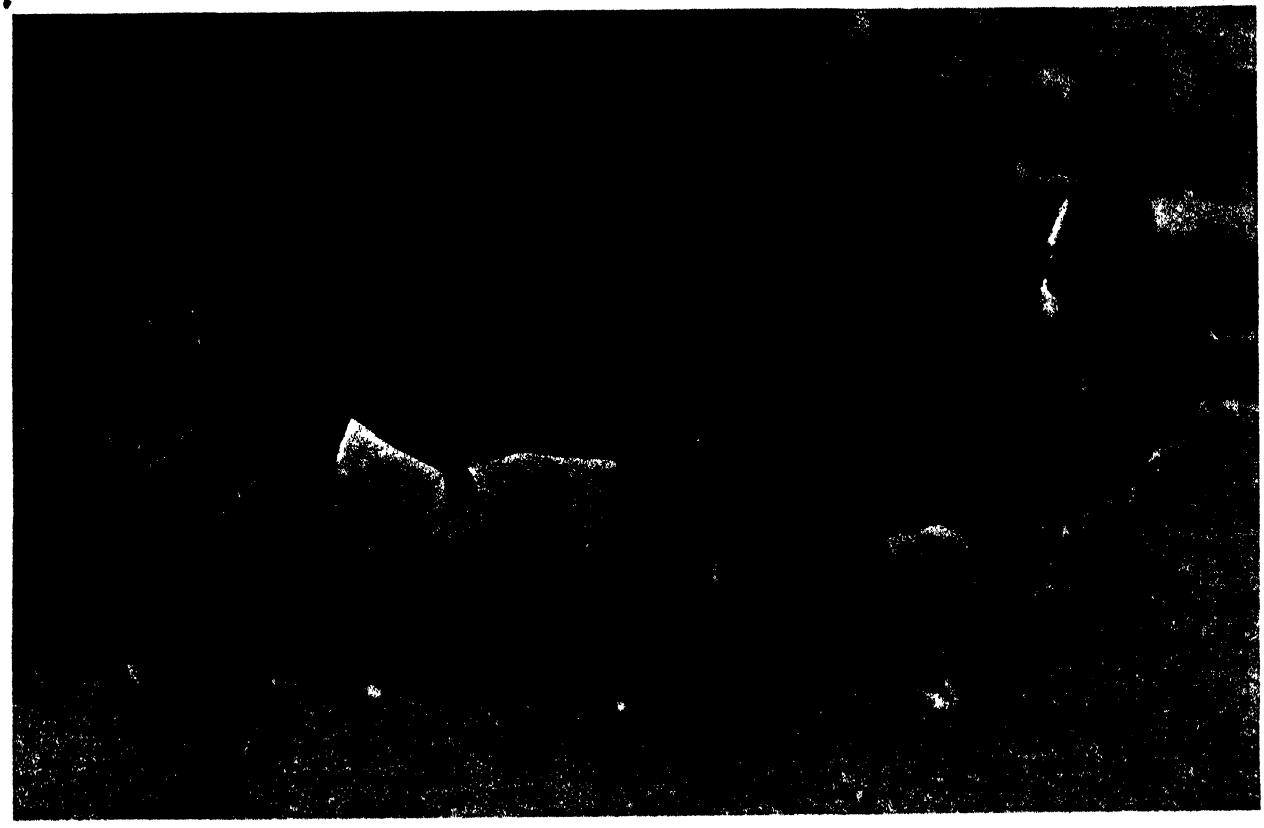
W. S. Berridge


W. S. Berridge

MANED WOLF AND BROWN HYAENA THAT ARE VANISHING

Very few specimens of this strange-looking, long-legged wolf (bottom) are believed to be now left in the wilds of Brazil, which are its home. It is called the red or maned wolf. The brown hyaena of Africa is also almost, if not quite, extinct. It was found south of the Zambesi, especially in coastal districts where it prowled on the beaches for crabs and dead fish.

E.N.A.



REMNANTS OF THE ONCE ENORMOUS HERDS OF AMERICAN BISON

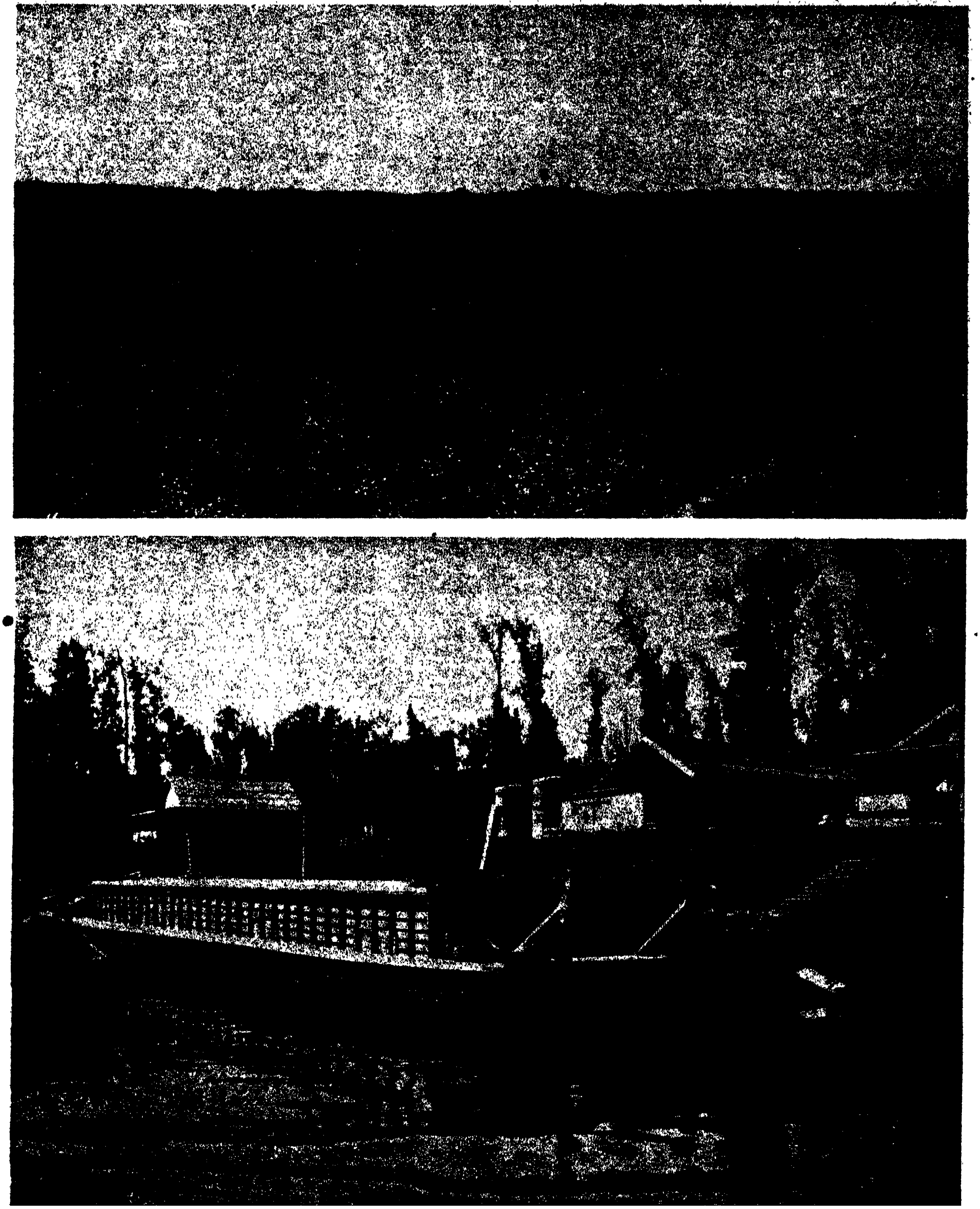
Most astonishing of all the stories of extinction is that of the American bison, which in U.S.A. is called the buffalo. Up till the 'seventies herds of almost incredible size wandered the prairies. In about twenty years these vast numbers were virtually wiped out. When we consider that a herd was observed on the move in Arkansas as late as 1871, and that it formed a mass of moving beasts, fifty miles long, and that this was just one company among many, the sheer immensity of the extirpation can be realized.

H J Shepstone

H J Shepstone

HANDLING BUFFALOES FOR TRANSPORT ACROSS THE UNITED STATES

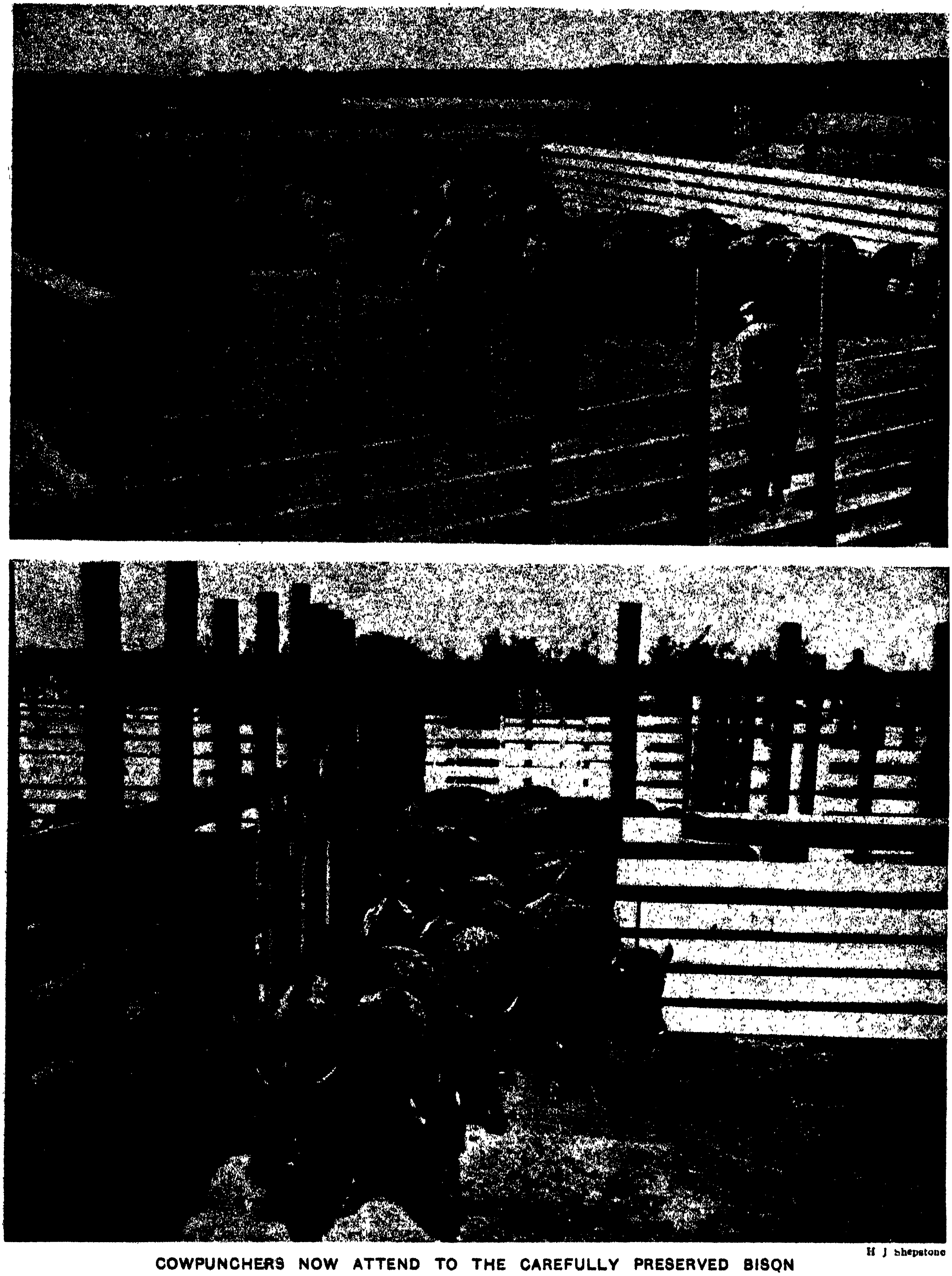
So extraordinary was the speed with which buffaloes disappeared that it has been suggested that some kind of epidemic helped to carry them off. But contemporary accounts leave little doubt that the work was done by crack shots "Buffalo Bill," subsequently proprietor of the celebrated "Wild West" show, undertook to supply the workmen on the Kansas Pacific railway with buffalo meat, and in eighteen months shot nearly 5,000 beasts. These photographs show the descendants of the old herds being handled for transport



H. J. Shepstone

BISON CAREFULLY PRESERVED IN THE UNITED STATES AND CANADA

The building of the trans-continental railway greatly helped in wiping out the bison herds, and the trade in hides was carried on with imbecile fury. By 1885 the chief industry to do with the animals was the collection, and manufacture into fertiliser, of the skeletons which strewed the prairies in hundreds of tons. There still survives a race of bison in Canada, in the Mackenzie Valley, where the lower photograph was taken. It shows a boat used for transporting the beasts. Above is a scene in Buffalo National Park, U.S.A.

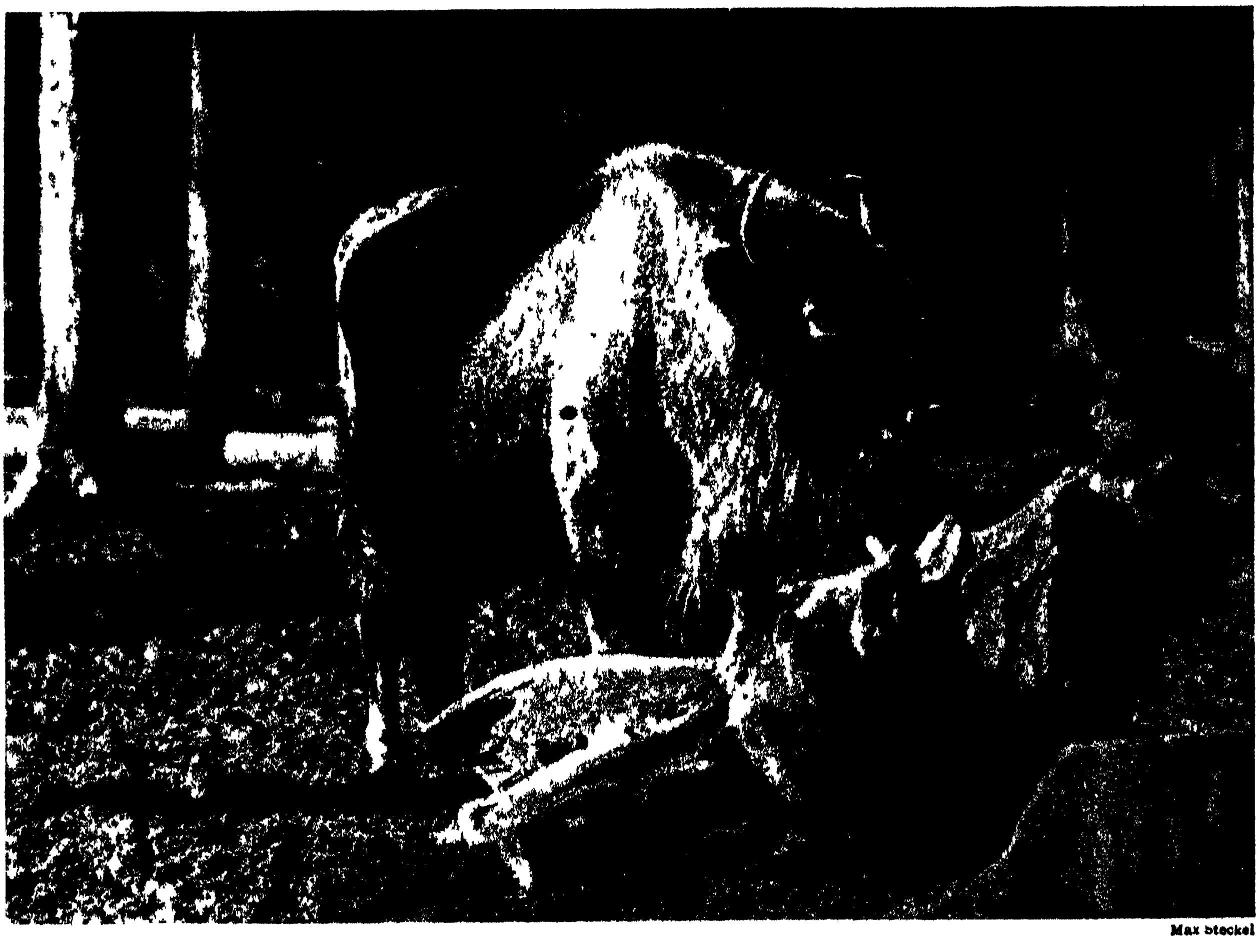


H J Shepstone

COWPUNCHERS NOW ATTEND TO THE CAREFULLY PRESERVED BISON

It is a far cry from " Buffalo Bill " and his crack shot associates to the cowpunchers of to-day, who are told off, not to destroy, but to tend the bison or buffaloes. These are preserved in various National parks, and when it becomes necessary to transport individuals from one part of the country to another the same methods are used as for ordinary stock. The lower photograph shows bison coming into a stock pen for branding, while above is a corral at Wainwright, with cowboys watching the great beasts.

F W Bond



Max Steckel

SOME OF THE LAST SURVIVORS OF THE EUROPEAN BISON

Taken in the great forests of Upper Silesia these photographs show some of the last of the wild European bison. These particular animals were the survivors of a herd on the vast estate of the Prince of Pless, to whom, in 1864, Tsar Alexander II had given a bull and three cows. In 1918 the herd numbered about 60, but the war and the revolution in Russia sealed its fate. Notice that the hump on the withers is much less pronounced than in the American bison, and that the European animals are more evenly proportioned

James

The suddenness of the collapse of the American bison has led some to doubt whether it should be attributed solely to the rifle of the hunter. It has been suggested that it may have been due in some part to the spread of epidemic diseases introduced by domesticated cattle. In reading the accounts of the wild and reckless slaughter, however, one gets the impression that no further explanation is needed.

The fauna of Africa affords many instances of animals that are threatened with extermination and some that have become extinct within recent times. In view of the enormous size of the continent and the small area that has yet been settled by Europeans, this may appear surprising, but it has to be remembered that many kinds of big game, particularly antelopes, have only a very limited range of distribution. Further, the universal diffusion of modern fire-arms among the natives has had disastrous results upon the fauna all over the continent.

W S. Berridge

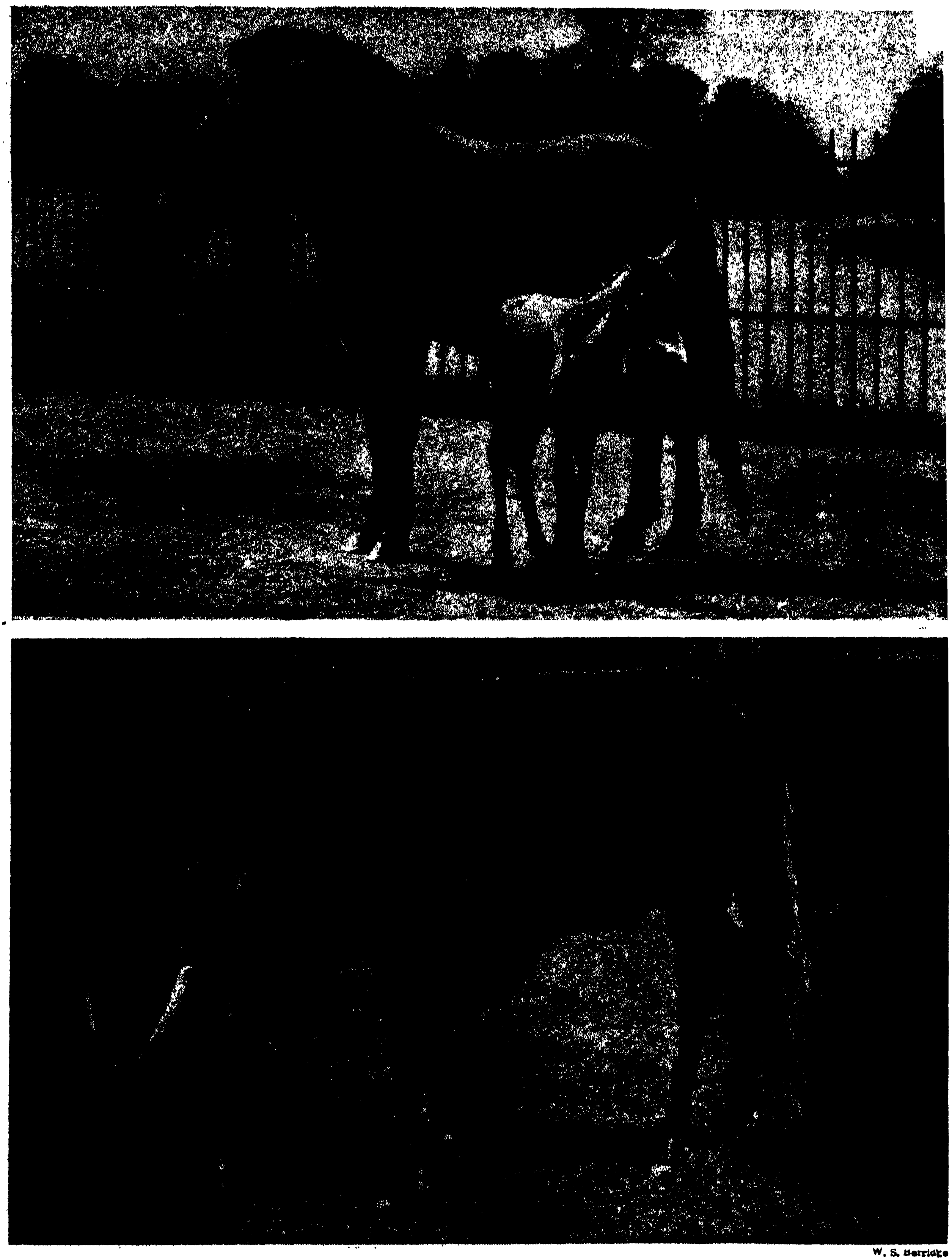
TAKIN, A NOW RARE RUMINANT OF CENTRAL ASIA

Living on the remote mountain-sides of Bhutan—where the lower photograph was taken—and in the north of Assam, the takin seems to be dwindling away towards extinction. Its road to oblivion is helped by the fact that its very rarity has led people to expend a great deal of time and trouble in shooting it. The takin stands about three feet six inches at the shoulder

W. S. Berridge

REPRESENTATIVES OF EXTINCT DEER FAMILIES IN THE LONDON ZOO

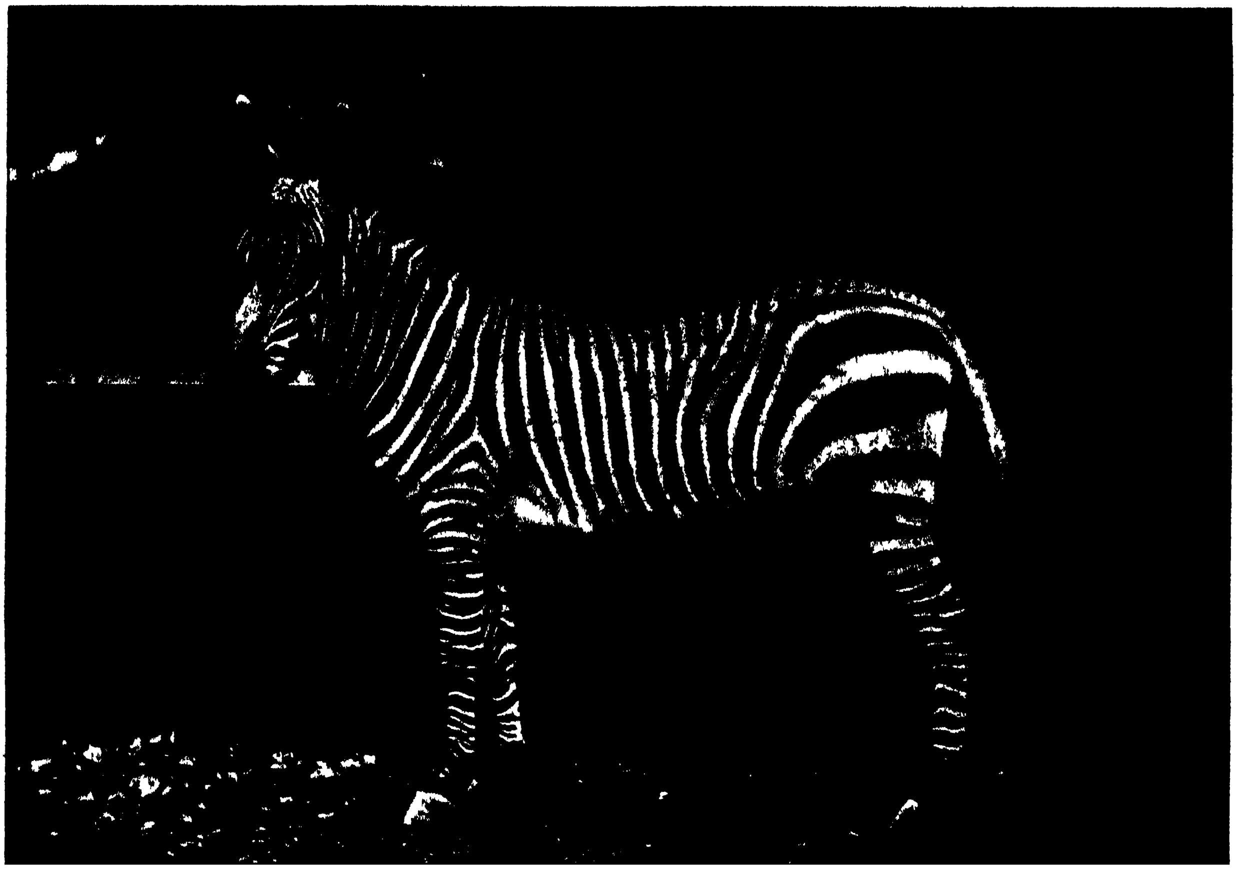
Père David's deer belong to a race of the Chinese water deer which were formerly kept in the park of the Imperial Palace at Pekin. The only specimens of Père David's deer known to be living are kept by the Duke of Bedford in the park at Woburn Abbey, and this solitary one (bottom) exhibited in the London Zoo. This kind of deer is fond of lying concealed in reeds. Above is of an example of Wallich's deer in the London Zoo where, at the time of the photograph, it was one of only two known survivors of its kind.



W. S. Berridge

WHITE-TAILED GNU OF AFRICA AND MONGOLIAN WILD HORSE

Africa, in spite of its enormous area and the comparatively sparse distribution of population save in a very few districts, has suffered losses in its fauna owing, partly at least, to man's intervention in the natural order of things. The range of certain animals, particularly of the antelope type, was very restricted and the possession of fire-arms by the natives has helped certain animals along the road to extinction. The white-tailed gnu (bottom) is now very rare. Mongolia is the last refuge of the wild horse (top).



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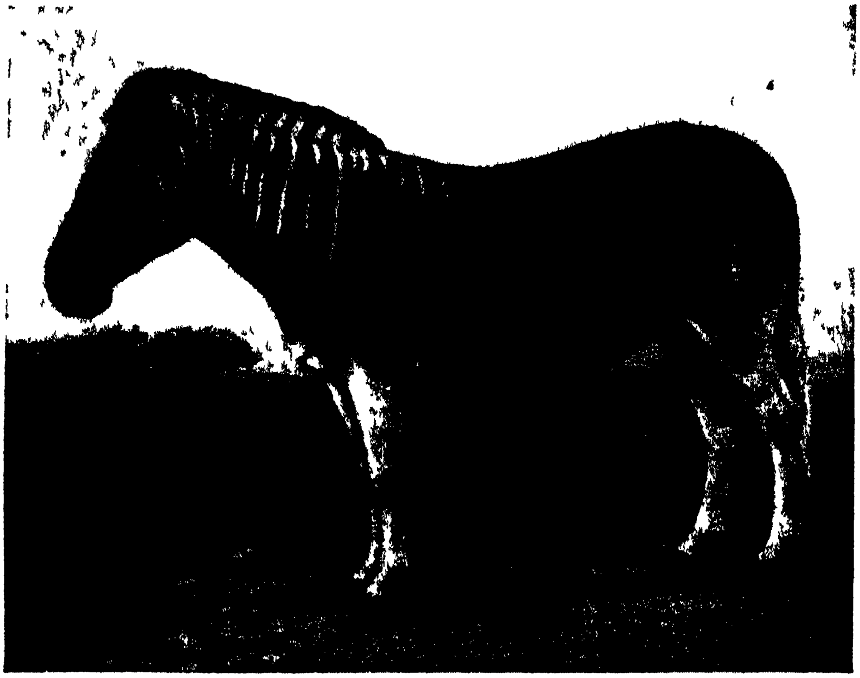


York & Sons

EXTINCT QUAGGA AND DISAPPEARING MOUNTAIN ZEBRA

Zebras have suffered greatly in various parts of Africa from the activities of hunters and natives armed with rifles. Several kinds are now much reduced in numbers and one, at least, the quagga (bottom) is now no more. The last survivor is believed to have been one that died in the London Zoo in 1864. Above is a specimen of the mountain zebra, now very scarce.

The African elephant has been hunted for the sake of its ivory from remote antiquity and has now disappeared from many regions where it was formerly common. Some local races or varieties of the species have certainly become extinct in this way. The Cape elephant, of which a small herd survives in the Addo Bush near Port Elizabeth, was almost exterminated some years ago by Government orders owing to the great damage it caused on neighbouring farms.

There is some evidence that a race of elephant formerly lived north of the Sahara and it may possibly have been this kind that was trained for war by the Carthaginians. In most of the British possessions in Africa elephants are now protected and in some districts they are stated to be increasing in numbers. It may be, however, that this is merely due to immigration from regions where they are more persecuted.

W. S. Berridge

BONTEBOK OF THE CAPE, NOW SURVIVING ONLY IN CAPTIVITY

Extinct as a wild animal, but still preserved in a few privately owned herds, the bontebok is a relative of the hartebeest. Its range was very restricted, having been confined to the sandy bush country round Cape Agulhas, which is the extreme south point of the continent of Africa. Possibly the bonteboks were cut off in this region by the drying up of the land immediately to the north, a process which has been going on for centuries. They would thus have evolved a distinctiveness of their own

Several kinds of zebra have been greatly reduced in numbers in various parts of Africa owing to the activities of native and other hunters, and one at least is known to be quite extinct. This was the quagga, a zebra striped only on the head and forequarters, which was once plentiful on the plains south of the Orange River. The last survivor of this species is believed to have been one which died in the London Zoological Gardens in 1864.

THE inhabitants of the sea are much less accessible to man's destructive powers than are those of the land, but they provide one instance of extermination which is surely the most expeditious on record. When Bering discovered, in 1741, the sea which bears his name, the great sea cow was abundant round the shores of Copper Island and Bering Island. Before forty years had elapsed, perhaps even in twenty-five years, not one was left alive. It was a near relative of the manatee and the dugong, but grew to a length of more than twenty feet. Steller, the naturalist, who accompanied Bering's expedition, has given us the only account of the living animal, but its bones are still to be found embedded in the sand of the islands which it formerly haunted.

It was easily killed, its flesh was good to eat, and the fur traders and sealers who followed in Bering's wake used to feed their crews on it, with the result that it was speedily exterminated. Kipling, in his entertaining story of "The White Seal," which gives a vivid picture of the life on and around the seal islands in Bering Sea, makes a little slip in regard to the sea cow. It will be remembered that Kotick found that sea cow could not talk "because he has only six bones in his neck where he ought to have seven." Whatever be the fact as to his taciturnity, the sea cow had seven neck-vertebrae, like nearly all other mammals but unlike his cousin the manatee, which has only six.

The only mammals, other than the sea cow and its relatives, which are completely aquatic and unable to come on land, are the whales. All the larger kinds of whales are, or have been, pursued by man in different parts of the globe for the sake of their oil and, formerly, of their whalebone. While no species is known to have been completely exterminated as yet, several have been brought perilously near to that limit and the present scale of the whaling industry threatens the very existence of all. Even with the simple methods of the old whalers,

British Museum

. S. Berridge

BIRDS EXTERMINATED BY MAN'S INFLUENCE

In 1507 the Portuguese landed on the island of Mauritius and found the dodo, a clumsy kind of flightless pigeon, in great numbers. About the end of the 17th century it became extinct owing to the persecution of rats and dogs introduced by man.

British Museum

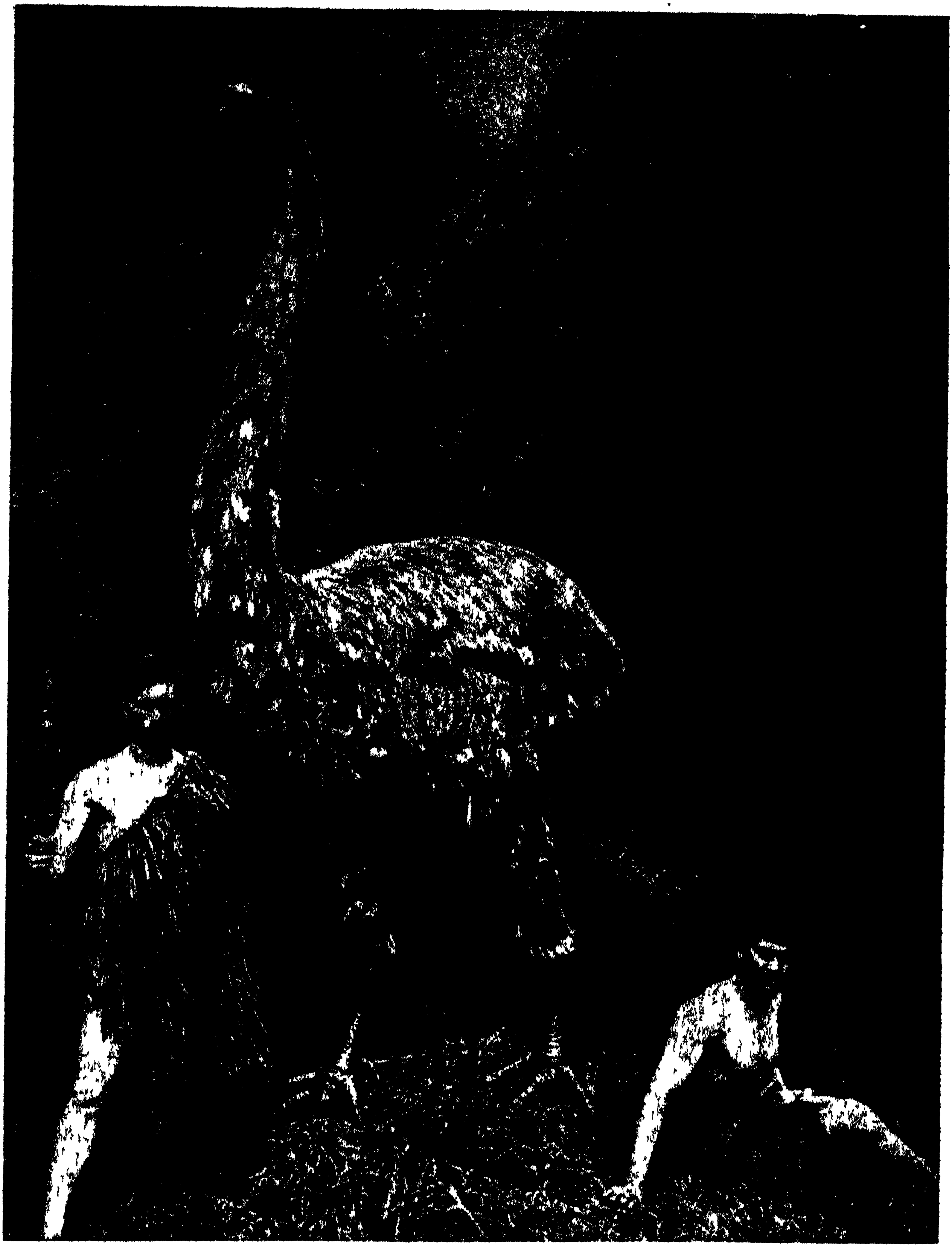
GREAT AUK WANTONLY KILLED OFF

Owing to its helplessness on land, the great auk was soon killed off when it was found to have a commercial value. The last survivor in Europe was slain about 1844. This strange bird was flightless and rather resembled a penguin.

when the whales were attacked with hand harpoons from rowing boats, several kinds of whales were so reduced in numbers that the industry died out in the regions where it first flourished. The right whale of the North Atlantic, hunted by the Basques in the Middle Ages off the coasts of the Bay of Biscay, has long since disappeared from there, although it lingers elsewhere in small numbers. The Greenland whale was the chief object of pursuit of British whalers in the 18th and 19th centuries at Spitsbergen and Davis Strait and was later hunted by the Americans to the north of Bering Strait, but the fishery has now ceased in all these regions on account of the lack of whales.

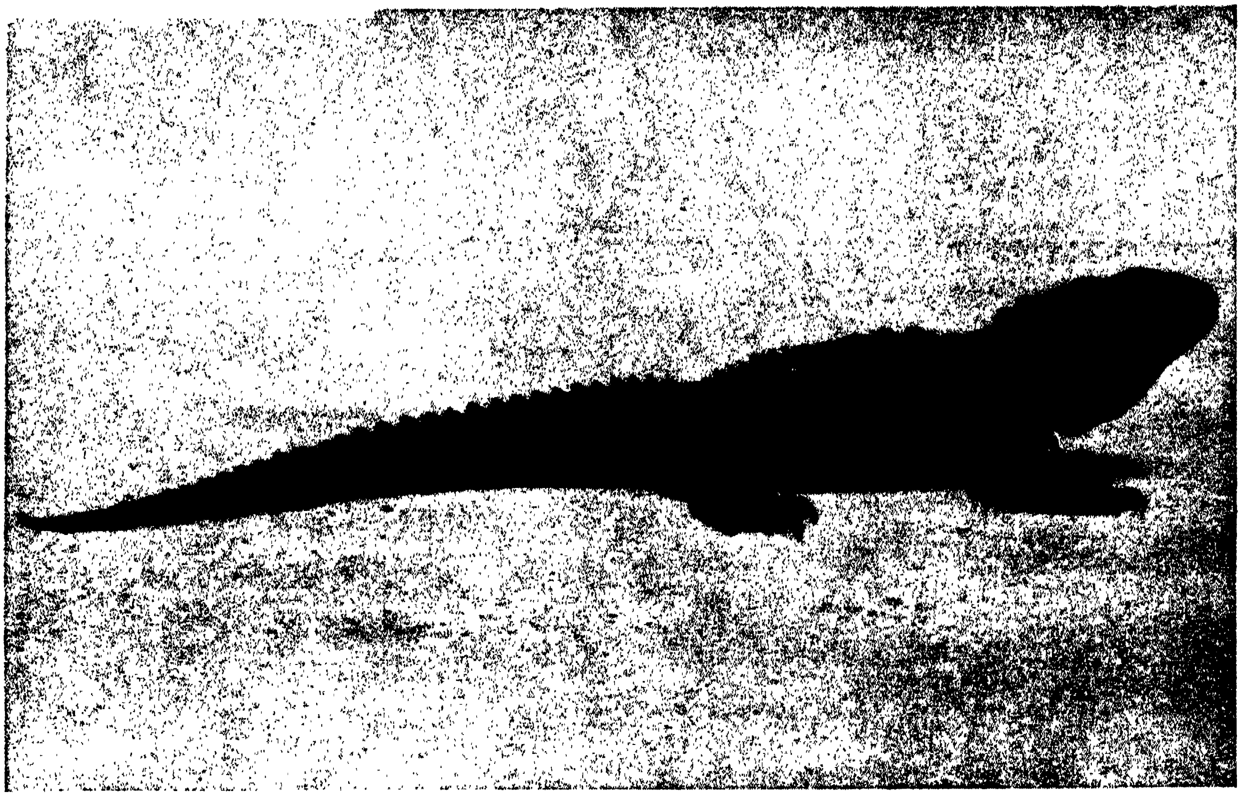
The introduction of the harpoon gun, with the explosive harpoon, in the sixties of last century turned the attention of whalers to the large rorquals, which it was impossible to hunt by the older methods. Particularly the great blue whale, the largest animal, so far as we know, that has ever existed, was extensively pursued in various parts of the Northern Hemisphere. Here, again, history repeated itself and the industry languished as whales became scarce. In the early years of the twentieth century, however, the rich whaling grounds of the Antarctic were attacked, and since then, especially at South Georgia and the islands to the south of it, whaling has been developed on a scale previously undreamed of. In the season 1925–26 some 13,000 whales were killed in this region. It can hardly be doubted that this wholesale destruction is a serious menace to the very existence of some of the species.

In all the cases that have been mentioned and in many others of a similar kind the part that man has

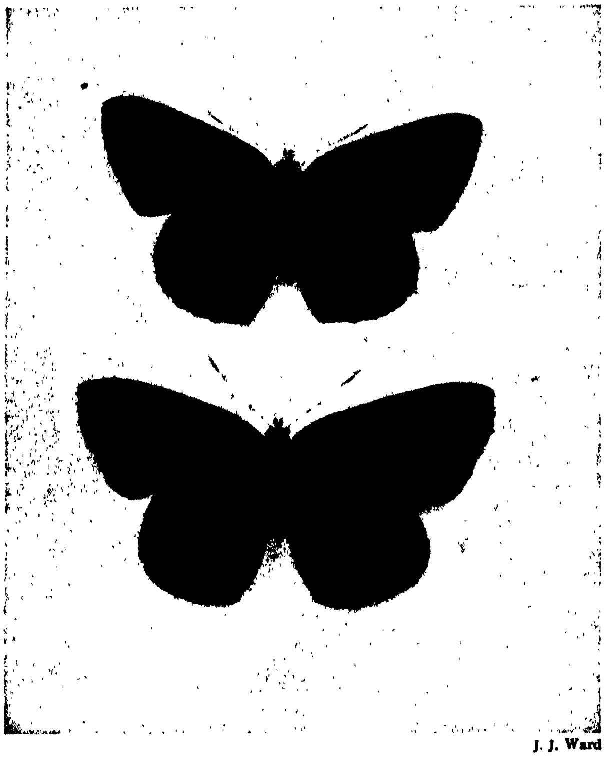


RECONSTRUCTION OF A MOA COMPARED WITH TWO MAORIS

There is a mystery about the moas, the giant ostrich-like birds of New Zealand which stood twelve feet high. It is impossible to say why they suddenly died out, for it does not appear that the Maoris can have harassed them, especially in South Island, sufficiently to wipe them out. Possibly some epidemic or climatic influence killed them off. They seem to have lingered on till the eighteenth or early nineteenth century. No white man is known to have seen one. The photograph is by the New Zealand Government



Neville Kingston



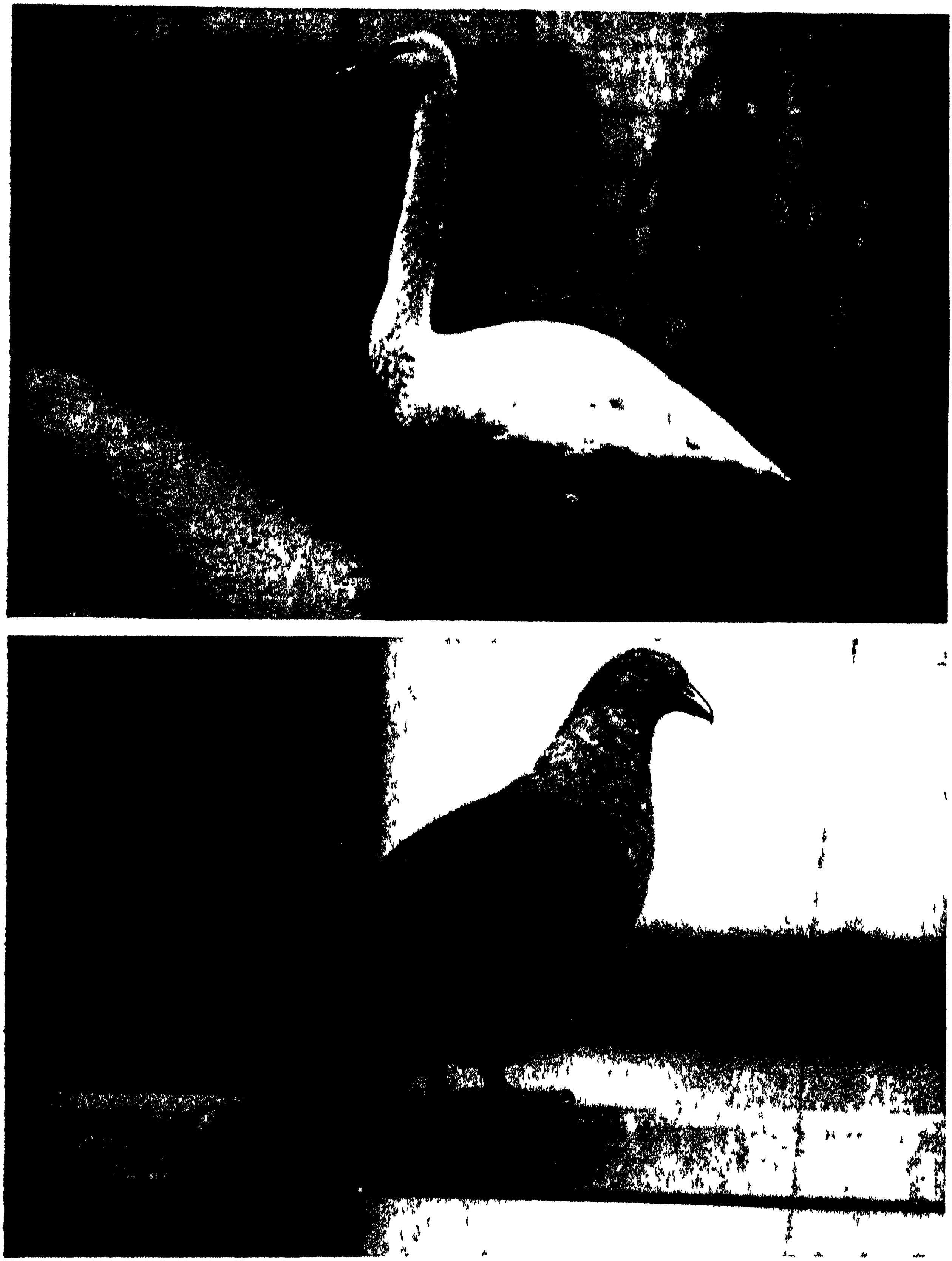
J. J. Ward

EXTINCT BUTTERFLY AND THE TUATERA

This handsome English butterfly, the large copper, seems to have disappeared about 1865 owing to the draining of the Fens where it lived. The tuatera (top) is a lizard whose relatives are now fossils. It is only found in some islands north of New Zealand

played is only too plainly that of a destroyer. Nevertheless it may fairly be questioned whether the blame for the extermination of some animals rests entirely with mankind. We know that countless species of animals that once flourished on the earth died out ages before man appeared. Whatever the causes of their extinction may have been, there is every reason to think that the same causes are operating to-day. It is quite conceivable that even if Mauritius had remained undiscovered, the dodo would still have died out. The sea cows, when Bering first saw them, were already the decadent and dwindling remnant of a once numerous and widely distributed family. Their extinction was hastened by man, but was probably inevitable.

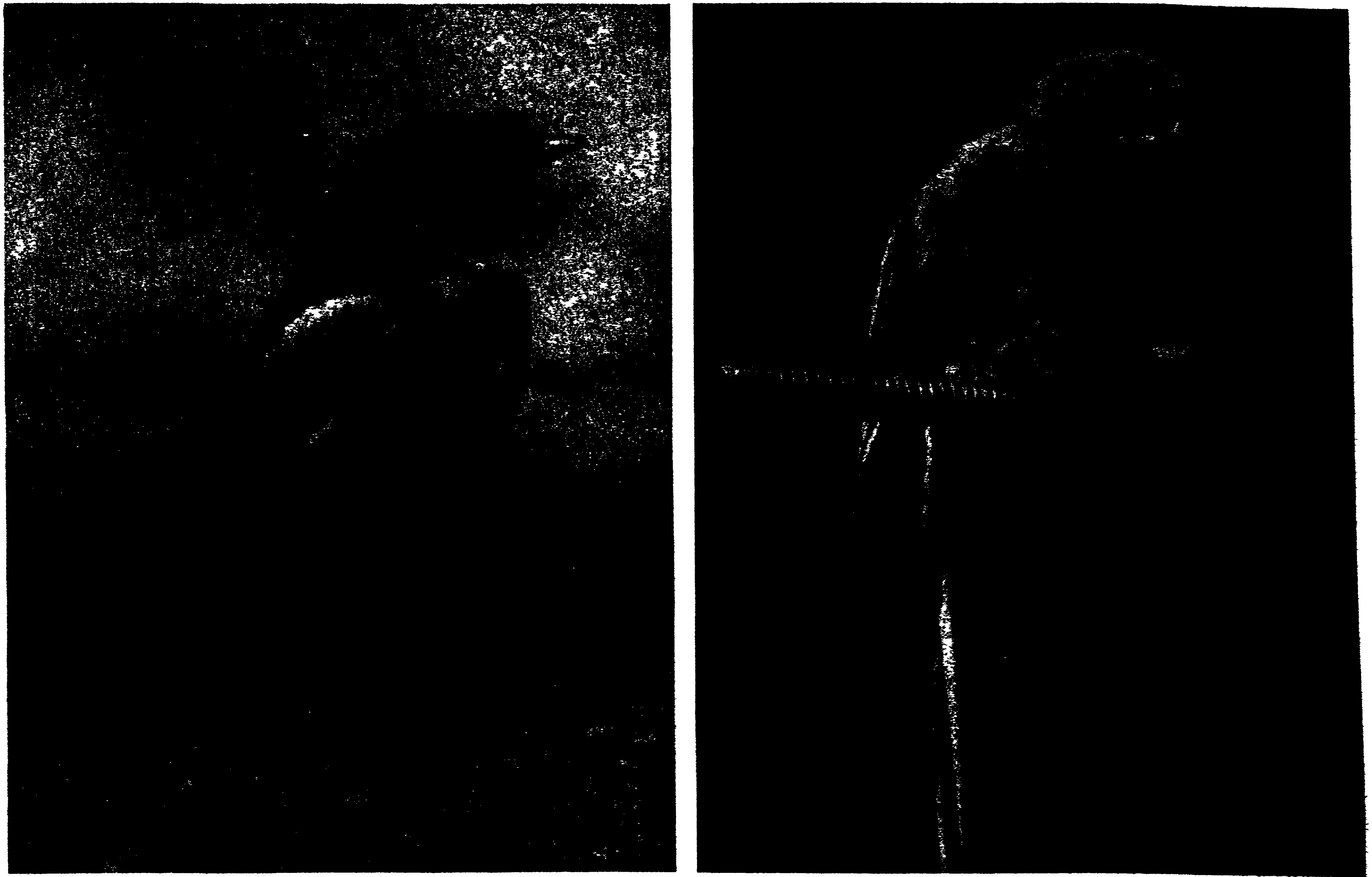
The day has long gone by when the "state of nature" could be regarded as a kind of golden age in which, secure from man's interference, the lower creation would "live happy ever after." Darwin has shown us that the state of nature is a state of war, ceaseless for all and ruthless to the vanquished. The continued existence of mankind may necessitate the disappearance of yet more of the types of life that still share the earth with us. But it is not mere sentimentalism that will deplore the necessity and will demand that we diminish as little as we can the variety and the wonder of the living world that our successors will see. A motor car is a wonderful thing, but it is not so wonderful as an elephant. It would be a poorer world if the last African elephant had been killed to supply us with billiard balls, even if Africa were as full of motors as Piccadilly.



W S Berridge

THE LAST OF MAYER'S PIGEONS AND THE TRUMPETER SWAN

Man has been blamed for the fact that various animals have become extinct But it should be remembered that, in a number of cases, the animal in question would have shortly become extinct in any case, and man only hastened the process The dodo, for instance, could not be regarded as being in a very flourishing state if it could only populate one island From the same place, Mauritius, came Mayer's pigeon, of which the last (below) was shown at the London Zoo in 1907. Above is a trumpeter swan, now extinct as a wild bird



W. S. Berridge

TALKING BIRDS: INDIAN HOUSE MYNAH AND THE BRILLIANT HYACINTHINE MACAW

Perhaps the most magnificent of the talking birds, from the spectacular point of view, is the hyacinthine macaw (right) *Psittacus hyacinthinus*. It is not often seen in captivity for the simple reason that it is rather difficult to obtain. Instead of occurring in flocks, as other of the parrot tribe so often do, it is usually only found in pairs or else in single families. It haunts the dense forests of Central Brazil up to the latitudes of the Amazon Its prevailing colour is a mauve blue, relieved by pale blue and a yellow band round the eye. The plumage is not only striking but brilliant in its colour. Our left hand photograph is of an Indian house mynah, a very entertaining bird and a great favourite in Indian homes.

Chapter CVII

The Talking Birds

By Oliver G. Pike

Author of "Bird Biographies"

Some birds are very clever mimics. Among the British birds the members of the crow tribe are the most proficient, and a few of these become quite clever talkers. But in every case this is simply mimicry, and there can certainly be no intelligence connected with it.

I have known a raven ask for food, but he had learnt that if he uttered certain sounds, food would be given to him. This raven was one of the very best bird-talkers I have ever listened to. While he was alone in his large outdoor aviary, he would talk to himself for an hour at a time; when I heard him I thought it was the gardener speaking to a friend. He spoke in a low, guttural voice, but the words that his owner had taught him were uttered very perfectly. These words really meant nothing to the bird, they were just certain sounds that interested him, and he picked them up in the same way that a canary will learn certain notes from the nightingale if it happens to be placed near one of these singers.

I once possessed a wonderful jackdaw. This bird never learnt to talk properly but he did make the most ludicrous efforts to repeat some of the things said to him. He was very good friends with most people that he met, but he had a very strong objection to one of my small boys, and he would chase him round the garden pecking at his legs as he ran behind him, all the time calling "Jaack, Jaack.' He would sit on my typewriter and go to sleep on the carriage as it jerked along, and when he had had enough he would open his eyes and hurl the funniest imitations of words at me. Once, and once only, he was so annoyed that he ripped the paper I was typing into shreds, and flung the pieces to right and left.

At one time there was a very cruel practice prevalent in England. It consisted of splitting the tongues of starlings and other birds, and it was thought that by so doing they were helped to talk. The result was that the birds found it impossible to utter their own notes, and the strange sounds they made were considered by some to be an attempt at talking. In some remote country districts this ridiculous custom is still carried on. I have never known a starling to talk, but it is nevertheless a very clever mimic. I once heard a duck quacking loudly at the top of a tree, and as this seemed such a strange place for a duck to settle, I looked carefully among the higher branches, and found the culprit to be a facetious starling!

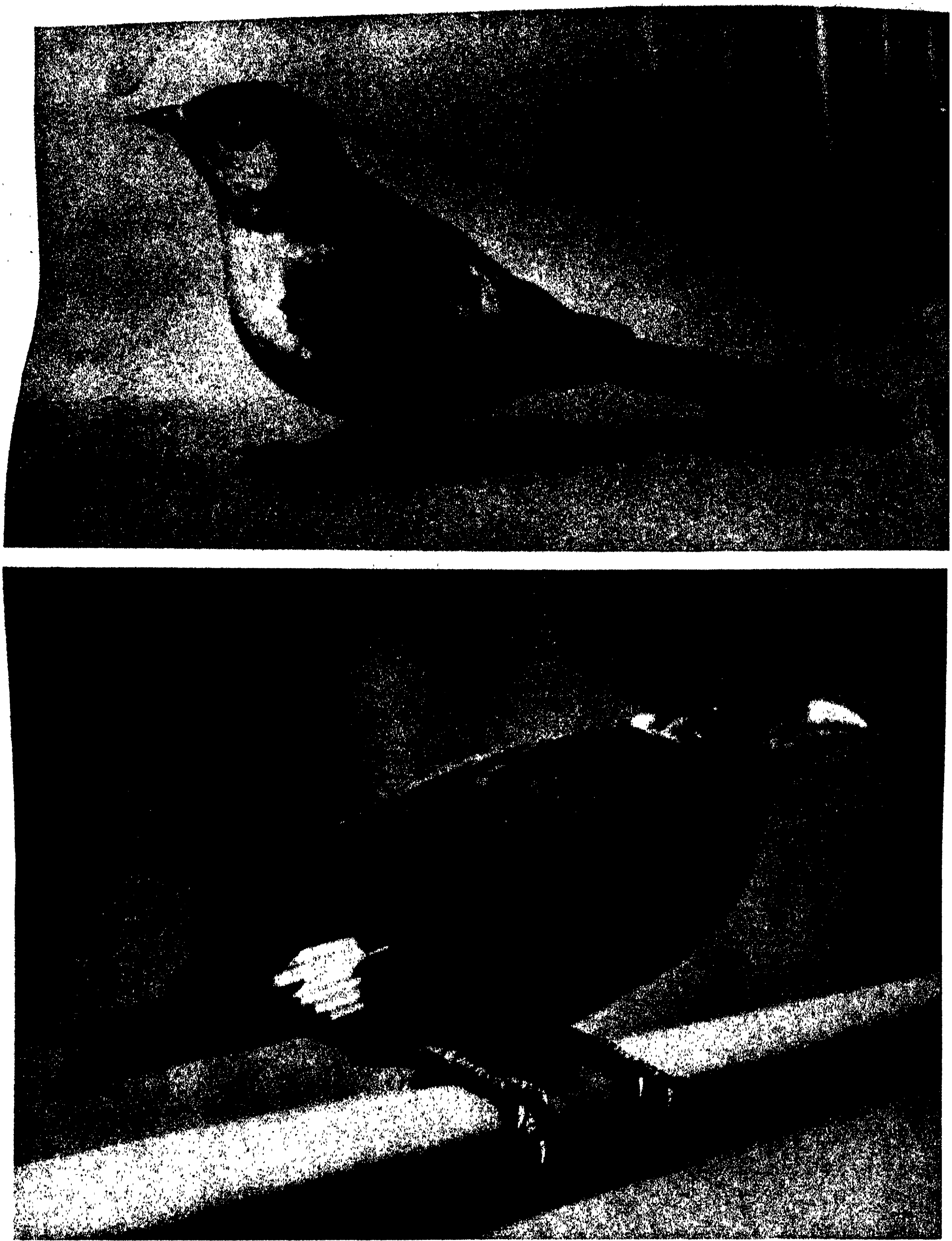
Parrots have the reputation of being very clever talkers, I have heard stories of them which seemed almost to prove parrot intelligence, but investigation has shown that the birds had been taught certain sentences, and when they spoke them correctly a special tit-bit was given to them. In time these birds discovered that they could obtain a definite prize if these words were uttered, and the fact that they had learnt this showed a certain amount of reasoning powers, but they certainly did not understand the meaning of the words.

One very clever talking parrot was the means of frightening a burglar. The man entered the house, and was preparing to look

W S Berridge

RED AND YELLOW MACAW

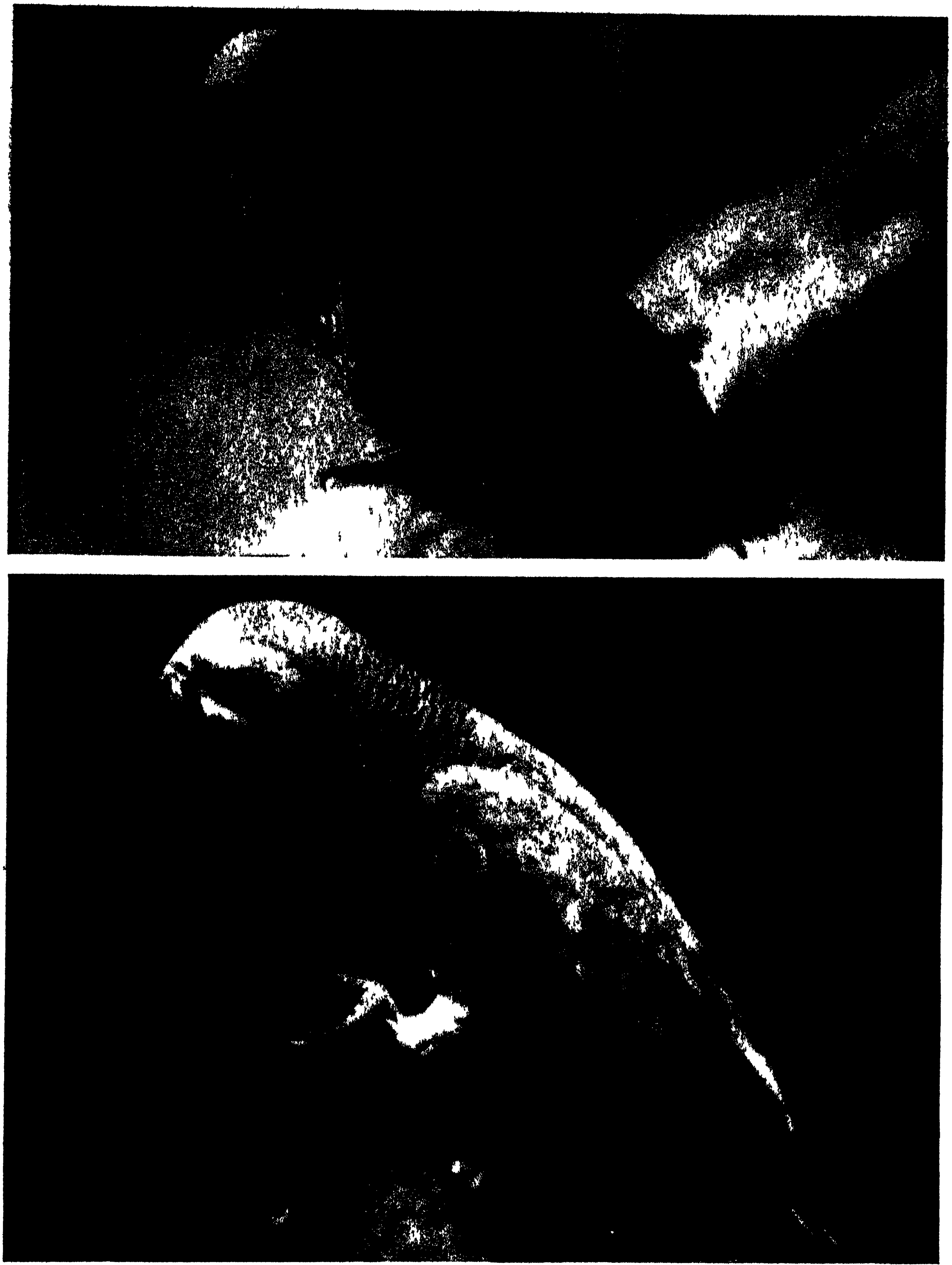
Ability to talk among the macaws varies considerably with the individual bird, but care and patience are usually rewarded in time. This particular macaw, the red and yellow, is to be admired as well for its ornamental qualities as for its talkativeness



W. S. Berridge

FAMOUS TALKING BIRDS OF INDIA AND AMERICA: MYNAH AND MOCKING-BIRD

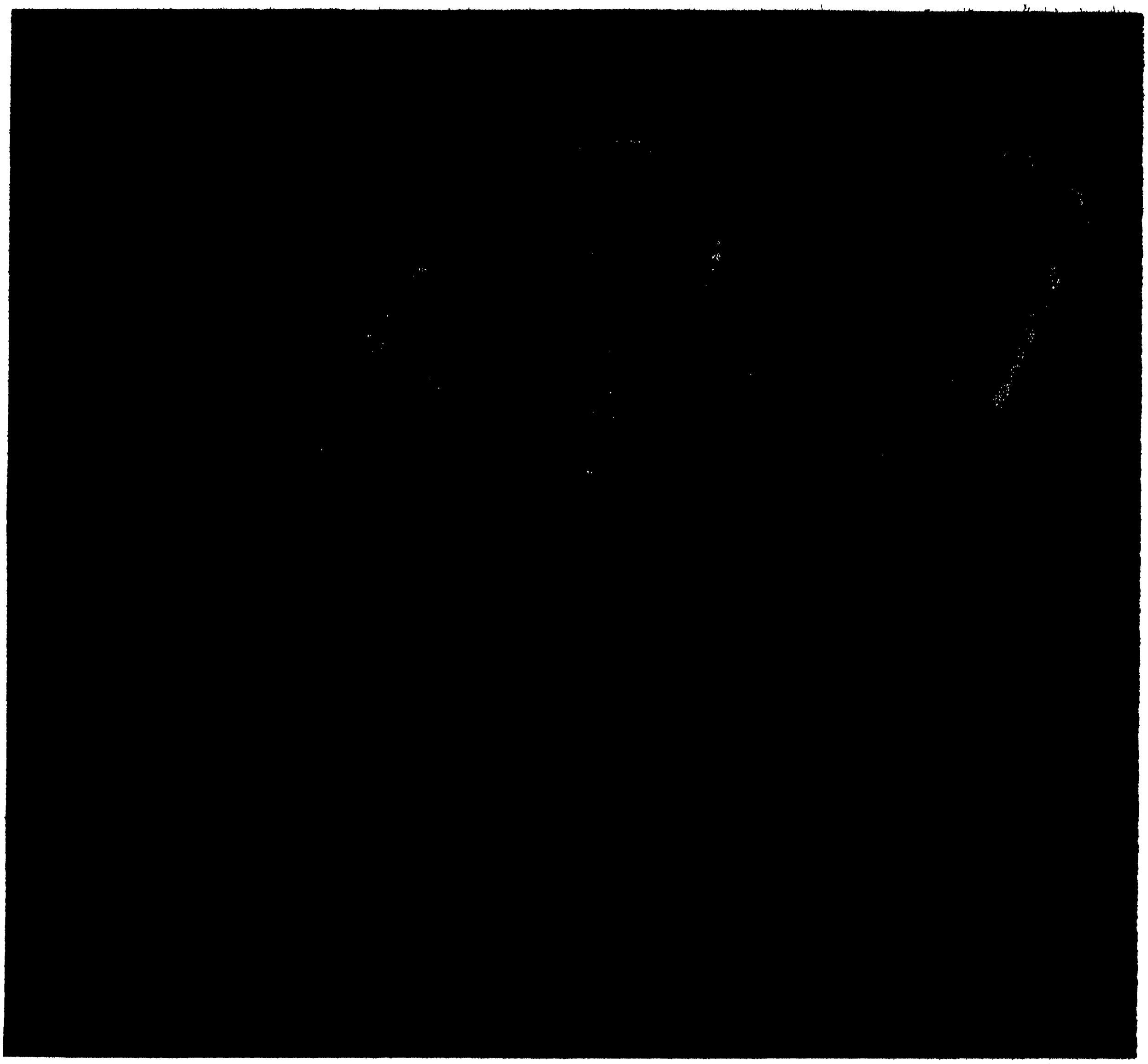
One of the best "talkers" among the birds is the hill-mynah (bottom). This is a species found over almost the whole of India, where it nests in hollow trees and holes in the sides of banks. It is black with brown underparts, and is a near relative of the British starling. This hill-mynah is often captured and made a pet of on account of its fine whistling powers and its ability to talk. The upper photograph is of a northern mocking-bird, which has a peculiarly long, flat tail. This bird is a very fine mimic.



W S Berridge

CHAMPIONS OF THE TALKERS BLUE-FRONTED AMAZON AND GREY PARROTS

So called because of the azure band above the beak, the blue-fronted Amazon (bottom) is found in Paraguay and Brazil in great numbers, and is considered the most teachable of the Amazon parrots Although individuals occur which will hardly talk at all, the majority are extremely teachable and are regarded as the easiest to train of all the South American parrots Some are even said to have been taught to sing whole songs The grey parrots of Africa are the most gifted of all the talking birds Here we have (top) a specimen from West Africa



W. S. Berridge

SUBTLY COLOURED BUDGERIGAR OR AUSTRALIAN LOVE-BIRD

A species of parrakeet very widely domesticated is the little budgerigar or Australian love-bird. The notes these birds utter, a kind of rich warble, give the impression of great affection, and since the birds are always caged in pairs the happy spectacle of domestic bliss has made this bird very popular. Though it is very rare for a budgerigar to talk it is on recored that a certain English actress possessed one which learned the name of successful plays and would recite them much to the delectation of all who heard it.

round when a guttural voice said: "Who goes there?" This parrot, which knew quite a number of sentences, by a stroke of luck, said the one most likely to scare the unwelcome visitor away. It must have been very startling for the intruder.

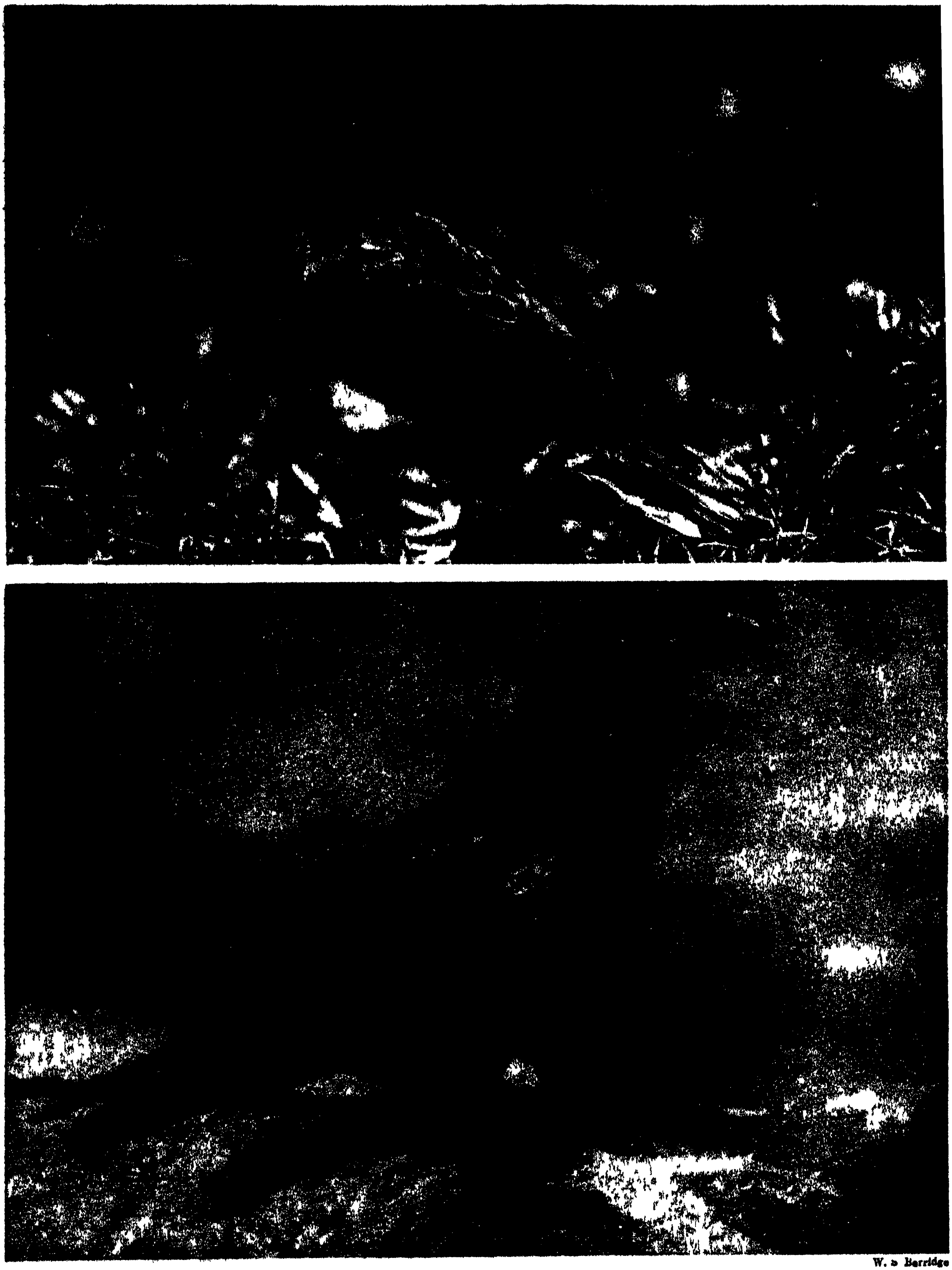
Rooks, crows and magpies have all been known to learn words which greatly pleased their owners, and although I have had birds shown to me which were supposed to be intelligent pupils and understood what they were saying, careful investigation has shown that these pets were just uttering blind words that to them had no real meaning. It is always difficult to say where instinct ends and reasoning begins. There can be no doubt that intelligent dogs, such as well-trained sheep-dogs, understand many things said to them, and I see no reason why they should not understand slow conversation spoken by their masters, but we cannot say the same about birds which have learned to speak a few words of our language. A friend of mine had a rook which he had reared from a nestling, and it was a very clever bird, and could say a few words, but these were simply repeated "parrot-like," and meant to him that he received a reward if he gave out certain definite sounds.

Although the smaller birds, such as the warblers, never learn words, they very soon pick up the notes of other birds, and the little sedge-warbler has been mistaken for the nightingale because he sings at night, and is a clever mimic, including in his song notes of

TALKING BIRD OF GORGEOUS COLOUR: BLUE AND YELLOW MACAW

Especially prized for their highly ornamental effect and for their large size—[illegible] of the [illegible] are three feet long—the macaws can be trained to talk in a very entertaining fashion. In a wild state they [illegible] the [illegible] that the great flocks of the [illegible]. In captivity the blue and yellow macaw [illegible] is a hardy bird and [illegible] the best talker among the macaws.

To face page 1724



W. S. Berridge

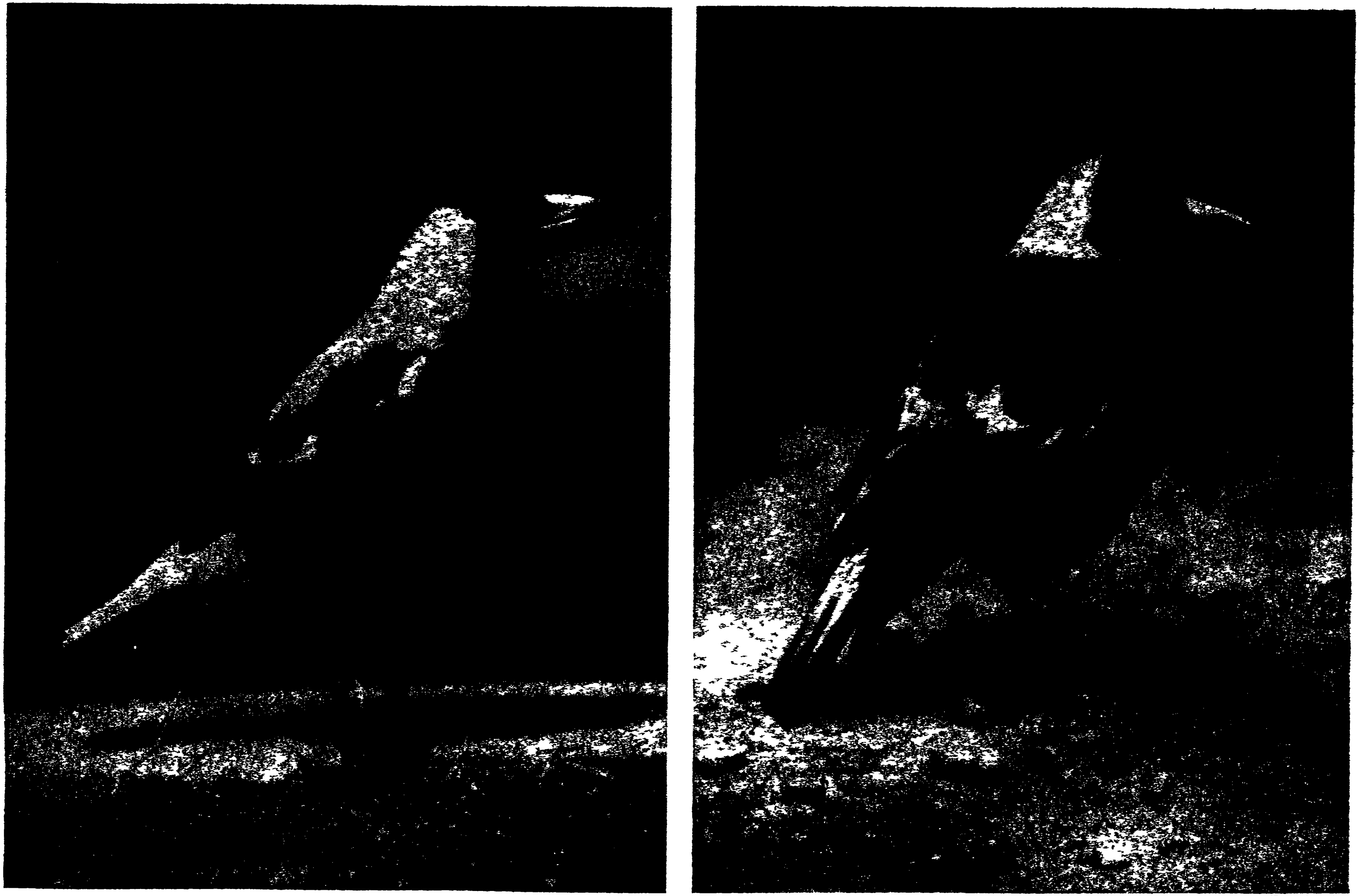
TWO BRITISH WILD BIRDS THAT CAN BE TRAINED TO TALK

Although the raven (bottom) is usually associated only with a croak it can utter many other sorts of sounds and some ravens will even learn to talk. These birds make most amusing pets, provided there is a garden for them to get about in, but, of course, amusement must be paid for and a raven is full of mischief and cunning. The starling (top) easily learns to talk, and is not assisted in its lesson by having its tongue slit as has been the cruel and ridiculous custom in the past. The only effect of this mutilation was to stop the bird's natural notes.

W S Berridge

EXCELLENT MIMICS AMONG THE BIRDS THAT CAN BE TAUGHT TO COPY THE HUMAN VOICE

To many people the only noise the jay (left) is known to make is a harsh screech, but often, when one supposes that a certain bird is calling it is really some mischievous jay using its great power of mimicry This bird can also make very good imitations of mechanical sounds, and it can occasionally be trained to utter a few words There are obviously possibilities in the jay, but they have been little explored owing to the fact that the bird is seldom seen in captivity and is not at all easy to catch as it haunts the densest thickets and the closest parts of spinneys and woods and is moreover exceedingly shy and wary As for the jackdaw (right), it can certainly be taught to speak if caught young and properly trained



W. S. Berridge

WHITE-BACKED AND BLACK-BACKED PIPING CROWS OF AUSTRALIA THAT CAN SING AND TALK

In Australia the piping crows are known as magpies. There are four species generally recognized of which we have two here: (left) the white-backed, and (right) the black-backed varieties. The latter is easily persuaded to become friendly and it is a favourite cage bird owing to its excellent powers of voice. Nevertheless, once caged, individuals vary considerably, some piping in proper full-throated manner, others in very subdued tones In its wild state the bird is found in territory that has been mostly cleared of timber, or in open plains where there is a fringe of trees. It will readily come to human habitations if given the least encouragement, and painstaking people can teach it to say odd words

COCKATOO BROADCASTING ON THE HUNDREDTH BIRTHDAY OF "THE ZOO"

During the celebration of the hundredth birthday of the London Zoological Gardens broadcasting was used in order to make the most of the occasion. One of the cockatoos was brought to the microphone for the entertainment of listeners. The bird deigned to imitate the sounds of kissing, but the performance had to end when the "artiste" tried to eat the microphone.

several other birds. I remember waiting in a "hide" to photograph a little grebe at its nest, and during the several hours I spent there, a thrush above me kept on calling "stick-to-it, stick-to-it." The notes were almost human, and it seemed as if he was encouraging me to continue. Many times I have been told by various people that a thrush in their garden had learned several human words. Thrushes vary very much in their singing, and many of their notes can easily be interpreted into words used by us.

There are birds at the London Zoo which will imitate sounds made by the spectators, but it does not follow that these birds have learned to talk.

An excellent talker is the Indian mynah, a ground bird related to the British starling. It nests in hollow trees, hedges and holes in banks and is insectivorous. Often its articulation is exceedingly good, and visitors to aviaries and zoos are often startled by hearing what is apparently a human voice when no people are visible who could have uttered it.

Chapter CVIII

Weapons and Warfare in the Animal World

By R. I. Pocock, F.R.S.

Of the Zoological Department, British Museum

In the generally accepted meaning of the word weapons are instruments of attack, and in that sense are contrasted with armour of which the function is essentially defensive. But in the animal kingdom it is not possible to draw a hard and fast line between the two. The spines, for instance, of sea-urchins, thorn-back crabs, globe-fish, hedgehogs and porcupines are in a sense weapons, although, since their function is passively protective, they are in that respect comparable to the " shells " of the snail, mussel, lobster, tortoise or armadillo which come into the category of armour. Weapons for attack are also equally useful for defence ; and it is not always easy to decide for which of the two purposes they were primarily developed.

A similar difficulty presents itself in the interpretation of the word warfare. Organized warfare, in the sense of concerted raids carried out bv castes of " soldiers," are restricted to such social insects as the ants, and the termites or " white ants." But the meaning of warfare must here be extended to the predatory persecution by carnivorous animals of those upon which they prey ; and this conception involves the application of the word weapon to teeth, claws, stings and other appliances used for killing, of which there is such an infinite variety that it is only possible to enumerate the most important. Under warfare must also be included the fierce combats in which the males of some of the more highly organized animals engage for the possession of the females at the breeding season. For these duels the rivals are often provided with special weapons and special armour.

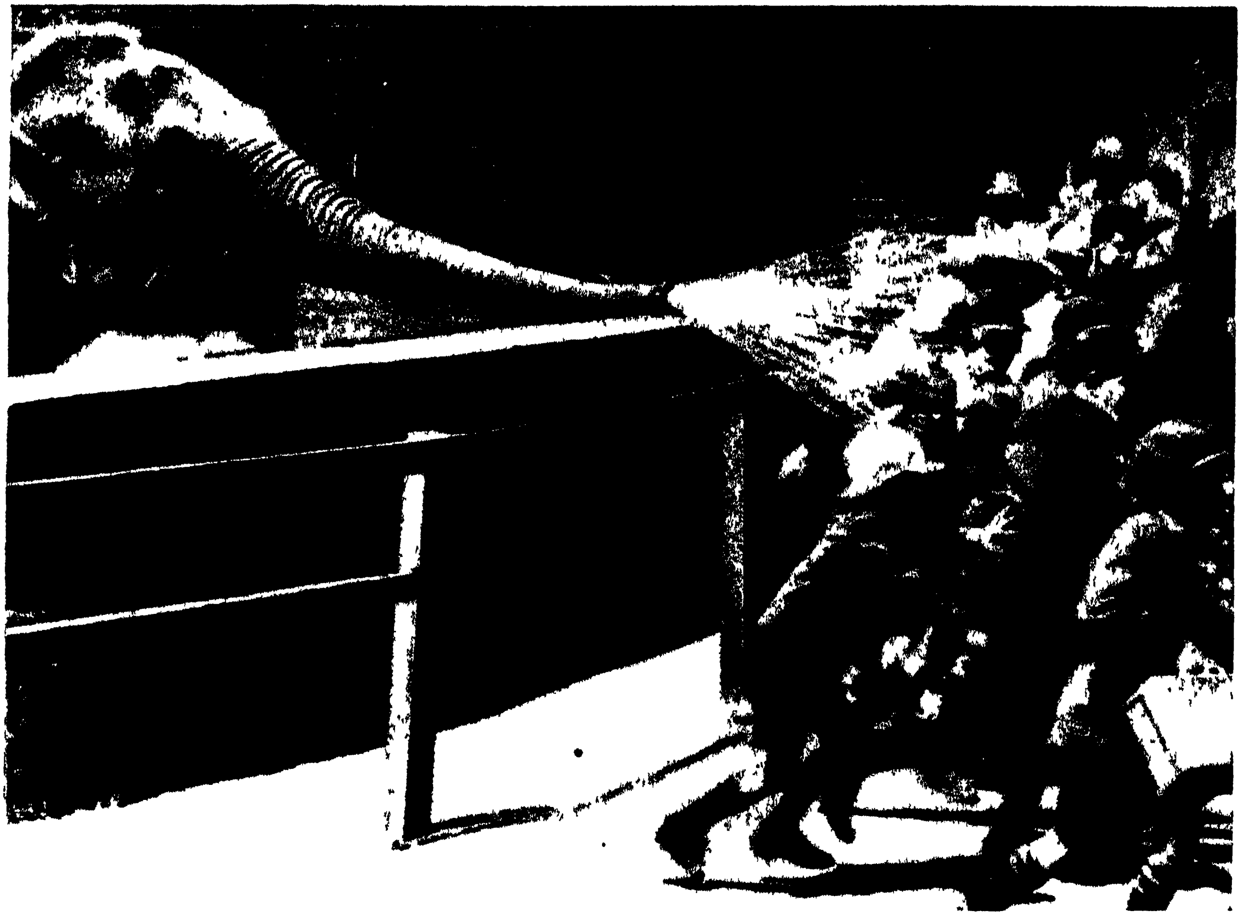
In the most lowly organized animals, the jellyfish and sea-anemones, in which definite weapons exist they combine the double function of killing prey and protection from enemies. They consist of remarkable batteries of microscopical stinging capsules similar in many respects to the stinging organs of nettles. Each capsule contains a fine, pointed, poisonous thread coiled up like a spring which is released under the stimulus of contact with another body so that the thread shoots out, penetrates any soft spot it touches, and instils its poison into the puncture. By this means these otherwise inactive, helpless animals are enabled to paralyse and kill their prey. The human skin is in most cases too tough to be sensitive to the prick of these minute darts ; but bathers who have unwittingly encountered big jellyfish in the sea have no wish to repeat the experience. It is well known, too, that very few fishes will eat sea-anemones because they dislike the irritation to the mouth and throat to which these stinging threads quickly give rise.

DANGEROUS WEAPONS OF THE BEAR

Contrary to popular belief, the bears use their fore limbs to strike with, and depend on the terrific blows they can give for defence. They do not use the hug for killing their prey or in self-defence. Here we see what dangerous weapons a bear possesses

Tentacles, or "arms," of various kinds for the capture of prey are found in many marine animals; but they reach their highest efficiency in the Mollusca known as cuttle-fishes in which the mouth is surrounded by eight or ten long, flexible but very muscular arms, each provided beneath with numerous suckers. Anchored securely to a rock by their suckers, cuttles lie in wait for passing prey, and woe betide the unwary fish that ventures within reach of one of the arms, and many are the stories of loss of human life from encounters with some of the larger kinds which may be colossal in size.

Very different from the prehensile tentacles of the anemones and cuttle-fish are the pincers or ' claws ' with which the hard-



EFFECTIVE WEAPON USED BY AN ELEPHANT IN THE MELBOURNE ZOO

Elephants have what seem to be very formidable weapons in their huge tusks. Yet these are chiefly used for uprooting vegetable food. The usual weapons used by the angry elephant are its feet, the animal charging the object of its wrath and trying to trample it underfoot. The elephant seen here, however, could not defend itself in this way from a pestering of small children. Therefore it used its trunk in this highly effective way Just so dangerous crowds are sometimes broken up with fire hoses instead of with more lethal weapons.

shelled crustaceans, like the crab and lobster, are provided. These powerful weapons are used for grasping prey and for fighting, and, as many of us know to our cost, are capable of pinching with surprising strength. The shell of crustaceans is also frequently armed with spines, more particularly the fore part of the head which, as in the prawn and others, is often produced into a long beak, perhaps especially useful in guarding the eyes from attack.

Pincers similar to those of the crab in structure and use are also found in the scorpions; but these terrestrial arachnids are further armed with a sharp spine carrying a pair of poison glands and jointed to the end of the body which is narrowed to form a flexible, muscular "tail." This tail is usually carried coiled over the back ready to strike in case of attack; but its main use appears to be the rapid killing of living prey seized by the pincers.

Poison glands are also found in another order of this class, namely, the spiders; but in this case they are lodged in the jaws and open at the tip of sharp fangs which are buried in the tissues of the prey. The action of the poison, as in the scorpions, is very rapid. Centipedes, too, have powerful poison jaws; but it is only the largest scorpions, spiders and centipedes which instil sufficient venom to be dangerous to man.

The whip scorpions, which are related to the spiders, have no poison glands, but they possess killing weapons in the form of a pair of powerful limbs armed with strong sharp spines which, when the limb is folded, impale and hold their prey exactly as a gin-trap holds a captured rabbit; and the strong grasping fore-legs of the mantis, a predatory insect akin to our cockroach, are instruments made on the same principle. The fore-legs of the large aquatic bug, called the water-scorpion, are somewhat similarly modified for the prehension of prey.

In other predatory insects, like the dragon-flies and many beetles, the jaws are the weapons for killing; but the ants, wasps and bees have a poisonous sting at the end of the abdomen. This is restricted to the female, the probe being a modified ovipositor consisting of a pointed sheath which makes the puncture, the poison being instilled by means of a couple of toothed styles which slide down the sheath and penetrate deeply into the wound. This apparatus is defensive in the nectar-feeding bees; but as a

Mondiale

HORNS AS WEAPONS OF OFFENCE AND DEFENCE: COWS AND GNUS FIGHTING

These dramatic photographs show the defensive as well as the offensive use of horns. Below we see two domestic cows fighting for the leadership of their herd before going up to their mountain pastures in Switzerland. Above are two gnus. As the two animals meet in a charge, the bases of their horns serve to deaden the shock and ward off the dangerous points of their opponent's weapon. These gnus were obtained as specimens for the Melbourne Zoological Gardens but, on being turned loose in the same pen, took a violent dislike to each other

[illegible]

PROBABLY THE MOST EFFICIENT KILLING MACHINE IN NATURE THE CROUCHING TIGER

Crouched and ready to spring, the tiger seems to be all weapon—a missile ready to be flung The great retractile claws, cruelly curved and always kept sharp, are joined to paws so powerful that a blow from either of the front pair can break the neck of an ox or a tear from the hind pair disembowel a horse Added to these weapons is the effect of the blow when the leaping animal's weight descends upon its prey at the end of the spring The tiger also has very powerful jaws armed with big teeth which show to great advantage in the above photograph This is almost certainly the deadliest killing machine in all Nature, combining, as the animal does, great agility with great strength

weapon for attack, it reaches its highest development in the predatory mason wasps, which feed their young on spiders and soft-skinned insect grubs. Many of the ants have powerful jaws as well as stings, and some of them first bite their prey then squirt the poison into the wound. An acid fluid discharged from the end of the body is also a weapon used by the bombardier beetles; but in this case, it is solely defensive, the liquid volatilising on contact with the air to form a puff of acrid smoke behind which the beetles retreat from an enemy.

From the infinite variety of weapons for attack and defence, or both combined, in the vertebrated animals it is impossible to mention more than a few of the most important in each class. Taking first the fishes, we find astonishing modifications in the structure of the teeth for killing prey of

Autotype

CAT AND DOG WEAPONS PREPARED FOR USE

Special circumstances do wonders in the modification of animal weapons. The bulldog was bred for seizing the muzzle of the bull in the old sport of bull-baiting. Thus the jaws, like a steel trap, and the nose, compressed so as to let the animal breathe while its teeth were fast in the bull, have been produced by breeding. Above is a Scottish wild cat.

Charles Reid

Autotype

DEER WEAPONS DEVELOPED FOR THE MATING SEASON'S FIGHTS

Wapiti stags are celebrated for the enormous antlers they grow, and this fine specimen from California admirably upholds his family traditions in this respect The upper photograph shows a group of red deer on the island of Arran. In the distance is Brodick. These great horns are not so damaging as might be expected, since the various branches catch in each other when the animals are fighting and the battle becomes a sort of pushing match. The vanquished can usually "live to fight another day."

GRECIAN IBEX IN DEFIANT POSTURE UPON A CRAG

The long backward curving horns of this Grecian ibex are well designed for inflicting dangerous wounds. The way they are curved gives an extra thrust to the upstroke of the head when the animal is butting, the mode of attack adopted by the ibex and all the other goats. Why this particular beast is standing with one foreleg raised is not clear. Perhaps he is challenging some rival male on the next crag. Those cloven hoofs are amazingly sure among the slippery rocks where the animal has its home.

SHOWING THEIR TEETH: DENTAL ORNAMENTS OF A LIONESS AND A DOMESTIC DOG

There is nothing like a good yawn for showing the full extent of an animal's dental equipment and its possibilities as a weapon. The yawning lioness (left) has a gape that could span a man's thigh, and the two murderous-looking canines in each jaw are nicely opposed and come together with dreadful force like the shutting of a mantrap Both teeth and claws are actuated by steel-like muscles, and these, backed by an almost invincible ferocity, make the lioness a terrible combatant. The terrier's mouth is built on the same lines, and it, too, has its four canines at the ends of its jaws It is these teeth that do the damage to clothes and limbs when a dog bites.

Francis [illegible]

FIGHT BETWEEN SEALS IN THE ARCTIC: CAT'S CLAWS VERSUS DOG'S JAWS

H. J. Shepstone

Seals are equipped with very sharp teeth, and can inflict a bad bite, although, to compensate for this, these animals are so protected by blubber that it would not be easy for a rival to find a vital spot save at the throat. Furthermore, while they remain on land these two fighters are not very active, and would find it hard to damage each other. The upper photograph shows the different attitudes adopted by cat and dog whilst sparring for an opening. The dog takes the active part, jumping round in a circle of which the cat is the centre. While the dog spreads its forelegs, the cat keeps hers stiff. The dog will have the advantage if it is only active enough to knock its adversary over. Otherwise the cat will be on the dog's back scratching its eyes out.

CAMELS THAT POSSESS DANGEROUS JAWS

Camels are strange, fractious creatures, and their tempers and their behaviour can never be counted on They can bite with fearful force, and as the attack in the case of, say, a camel driver is often not made at the time of injury but some time after, it is all the more likely to be effective These photographs show the dangerous looking jaws these animals possess

different kinds, the most formidable in the way of wounding being those of the wolf fish, angler and some sharks Of particular interest is a member of the shark tribe, the saw-fish, in which the snout is prolonged into a great blade with sharp teeth implanted on its two edges. With this weapon the saw-fish lacerates the bodies of its victims, tearing off great pieces of flesh to be swallowed.

A somewhat similar weapon, but pointed and without teeth, is found in the sword-fishes, large, swift, ocean fishes which use their weapons for transfixing prey. There are cases on record of their charging and piercing the bottoms of ships in mistake for whales. In their encounters with cetaceans, sword-fish are said by sailors to be helped by the thresher sharks which, leaping high in the air, lash the victims with their long tails as they descend.

But this use of the shark's tail as a weapon of attack has been denied by naturalists.

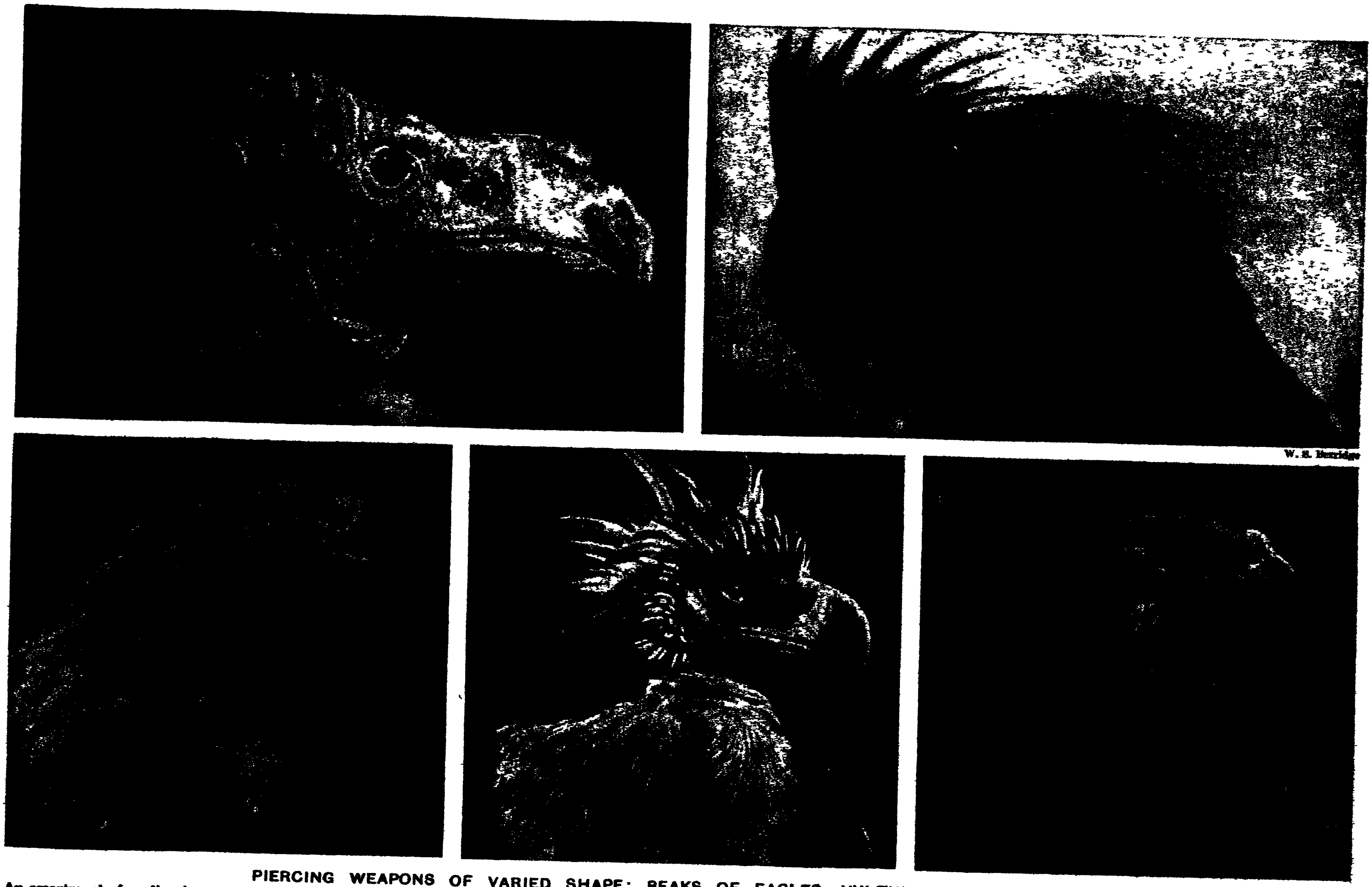
Not less varied than the teeth of fishes are the defensive weapons, in the form of spines with which many kinds are armed. The dorsal spikes of the common stickleback are a well-known instance. Somewhat similar spikes are developed on the back in the spiny dog-fish, the trigger-fish, and others; and the sharp barbed spike wielded by the long, lash-like tail of the eagle ray and sting ray is capable of inflicting a deep wound. It is in connection with such spines that we find poison glands developed in fishes. The British weaver-fishes, for example, have a poisonous spine on the plate that covers the gills and also on the back; and bathers who have stepped on them buried in the sand can testify to the acute pain that follows the puncture. But perhaps the most remarkable weapons possessed by fishes are the electric batteries found in several fishes of which the marine torpedo, one of the rays, and the South American fresh-water electric eel are the best known types. In the torpedo the batteries are placed on each side of the head, in the eel in the upper part of the tail. The shocks from these batteries are used for killing or stunning fishes which are then devoured; and their defensive properties will be appreciated by anyone who has had the temerity or the misfortune to touch one of these living electric machines.

W. S. Berridge

DEFENCES OF SKUNK AND WALRUS

While the skunk (bottom) relies for defending itself not upon strength but upon the power to discharge a squirt of the most foul smelling liquid from special glands the walrus (top) goes in for heavy tusks, of which even the polar bear knows well that it must take care

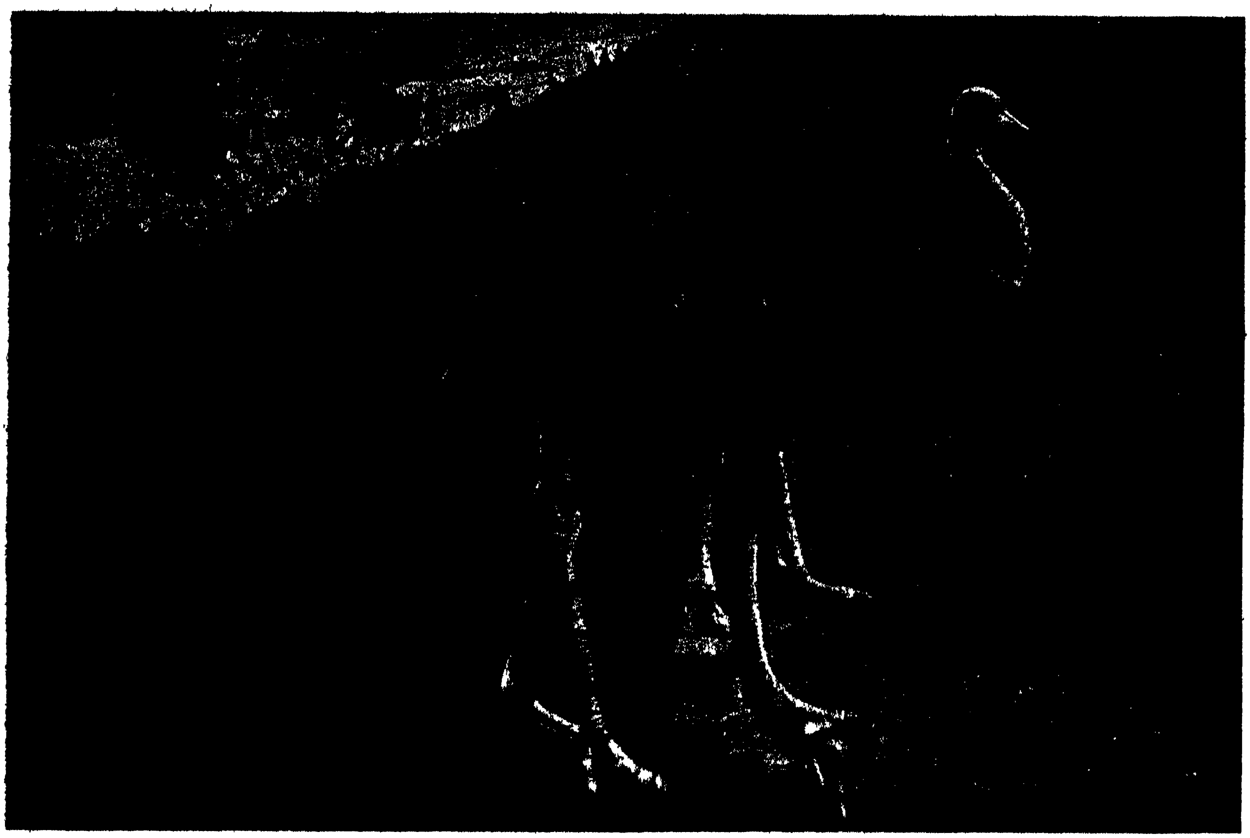
THE amphibia, or frogs, toads and newts, are singularly devoid of weapons unless distasteful glands in the skin come under that category. But many reptiles are well armed. The sharp interlocking teeth, embedded in vice-like jaws, of the crocodiles and alligators are capable of holding under water and drowning even large land animals that come to the riverside to drink; and many of the larger lizards and non-poisonous snakes, like pythons, can inflict very painful bites. The tail, too, is an important weapon in this class. Crocodiles, when on land, use it with great precision to knock over any unwary animal suitable for eating that comes within reach; the blows of the long tails of monitor lizards sting like a whip, and in the case of other lizards, like the mastigures, the strokes of the tail are rendered doubly disconcerting by the rows of sharp spines that encircle



W. S. Berridge

PIERCING WEAPONS OF VARIED SHAPE: BEAKS OF EAGLES, VULTURE AND A COCKATOO

An assortment of medieval arms shows hardly more variety than the weapons of the birds. They have piercing implements of every sort of shape and the five photographs above give us a few examples from among the many. First, we have the vociferous sea eagle (bottom left), with its cruelly curved beak; then comes the tremendously hooked bill of the monkey-eating eagle (bottom centre). The fishing eagle is fierce of both beak and claw (bottom right), while the vulture adds a repulsive hood of horribly wrinkled skin to the threat of its curved beak. The great black cockatoo has an amazing-looking beak which curves back almost as though it would grow through its owner's throat.

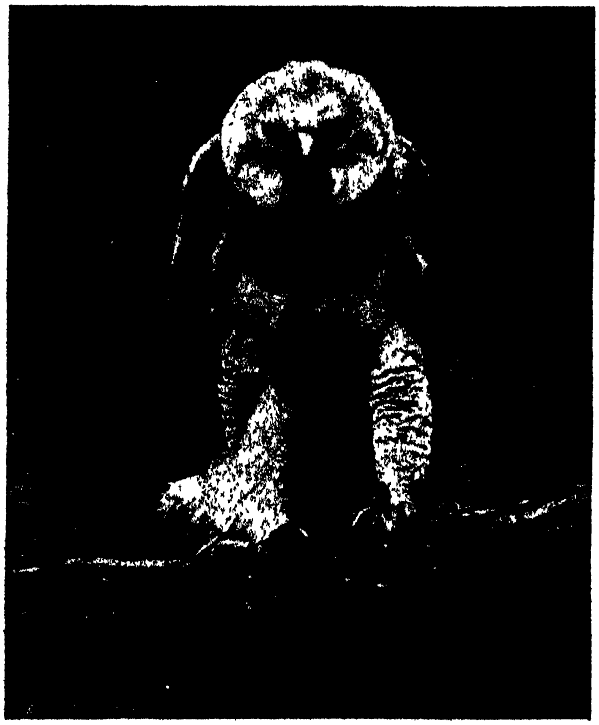


E.N.A

snakes, however, like wasps, scorpions, and other venomous animals, are for the most part not aggressive, unless interfered with, and use their poison mainly for killing prey; but the hamadryad or king cobra has been known to attack man without intentional provocation.

Some of the African cobras have learnt to use their poison in another way, namely, by spitting it in showers in the face of an adversary. The fluid is very irritating to the eyes and probably the habit is a useful defence against enemies like mongooses and secretary birds. Possibly in the category of weapons of defence in reptiles should be included the rattle of the rattlesnake. This is a sounding organ at the end of the tail which is useful to the protectively coloured viper, which does not wish to be stepped upon, by warning passing animals to be careful where they tread. Some other poisonous animals, the big scorpions and spiders, for instance, have analogous organs emitting sounds which, although inaudible to the animals themselves, are audible to their enemies.

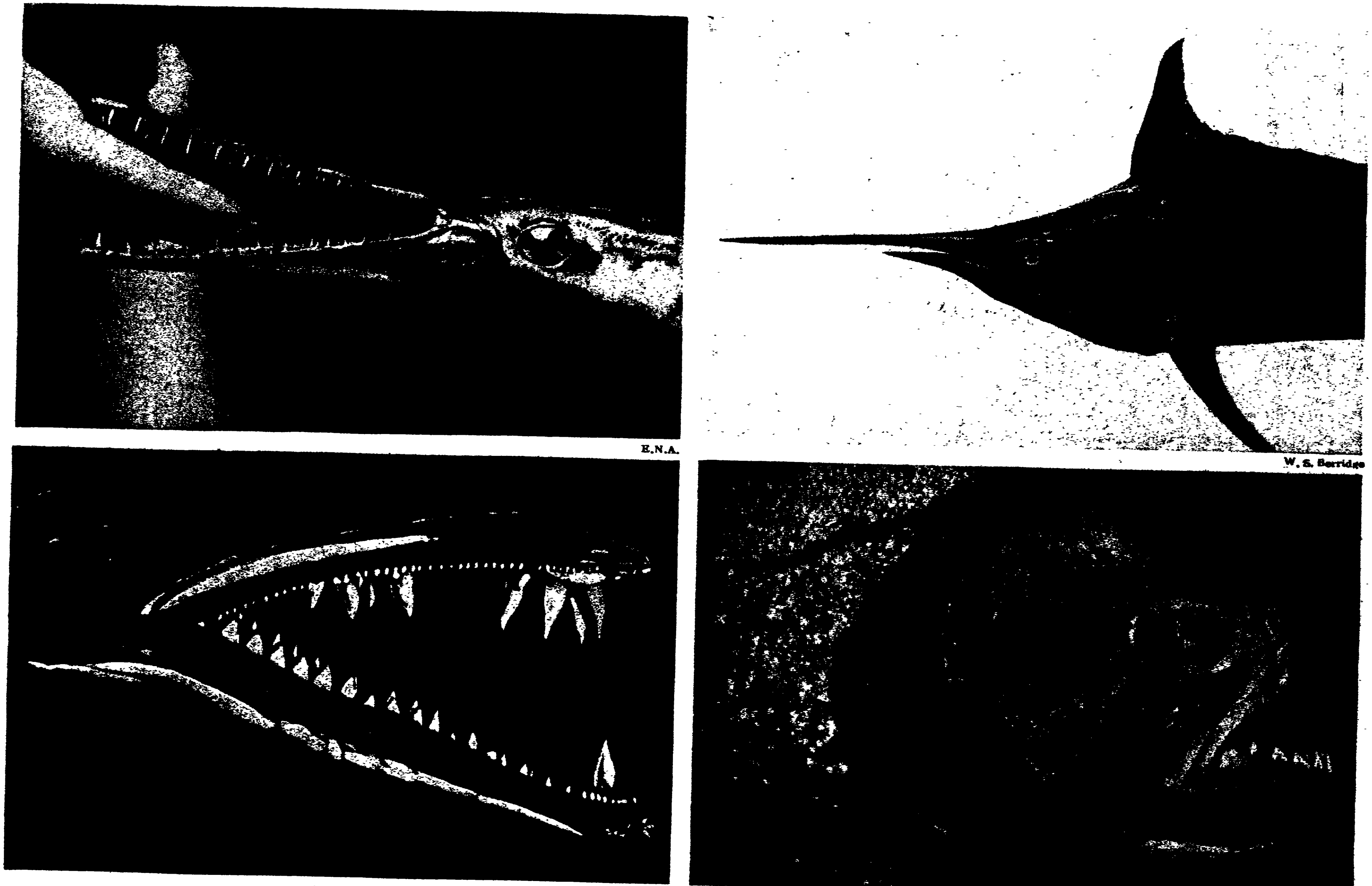
In connexion with the weapons of birds, the first point to note is the absence of teeth and the modification of the jaws into a bony beak encased in a horny sheath. Since beaks have already been dealt with in a chapter by Mr. Frank Finn (pages 59–64), they require only brief consideration here. The beak is the weapon commonly used by birds for killing prey and also for self-defence, as those who have handled



James

HARPY EAGLE AND OSTRICH

Staring threateningly at the photographer the harpy eagle (bottom) grips its perch with its strong sharp talons and shows us a beak that is a weapon indeed. Above are two ostriches whose weapons are their powerful quick-kicking legs.



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W. S. Berridge

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E.N.A.

SAWS OF SOME OF THE PREDATORY FISHES AND THE CRUEL TEETH WHICH LINE THEM

Famous as a sporting fish for which hundreds of anglers visit the Bahamas every year, the barracuda (bottom left) has a vicious, pike-like head and teeth which make it as much, or even more feared by bathers than the sharks. The fish in the bottom right-hand photograph is a piranha and was caught on one of the islands at the mouth of the Amazon It was captured with a piece of meat tied to a hook, its grip on the bait with its terrible teeth being so tight that the fish allowed itself to be hauled from the water rather than let go. Above we have (top left) a garfish with its extraordinarily prolonged jaws and (top right) a sail fish.

Otho Webb

even small birds, like robins and sparrows, are aware. Its efficiency depends upon its shape and size and the strength of the jaws. Even in grazers, like geese, it is a powerful, pinching instrument, and in parrots it is capable of inflicting a very painful wound. In the storks and herons perhaps, it reaches its highest development for offensive and defensive purposes. In the birds of prey, like owls, hawks and eagles, it is short and hooked and modified mainly for tearing prey already killed by the strong, sharp talons ; and in these birds we find the feet, with their muscular clutch and long, penetrating claws, are the principal weapons. Other strong legged birds also use their feet. Ostriches and cassowaries, for instance, deal powerful blows with them, and in the case of the cassowary the efficacy of the stroke is increased by a great lacerating claw on the inner toe. Game birds also use their feet to great purpose when fighting.

Many birds, like the pigeons and swans, which have feeble beak and legs, employ their wings as weapons, striking hard with the carpal angle or the edge of the wing below it ; and in a few species this area of the wing is specially armed with sharp spurs, there being one such spur on each wing in the jacanas, spur-winged plover and spur-winged goose, and two in the screamers, the last being South American birds with powerful flight and as big as turkeys. Birds, however, as a class are comparatively poorly equipped with weapons because their flight gives them a ready means of escaping from enemies not so gifted.

Otho Webb

STING-RAY AND TIGER SHARK

Much broader than a man and one of the most deadly fish that swims is the sting-ray (bottom). It and the thirteen-foot tiger shark seen in the upper photograph were caught off the Barrier Reef of Australia.

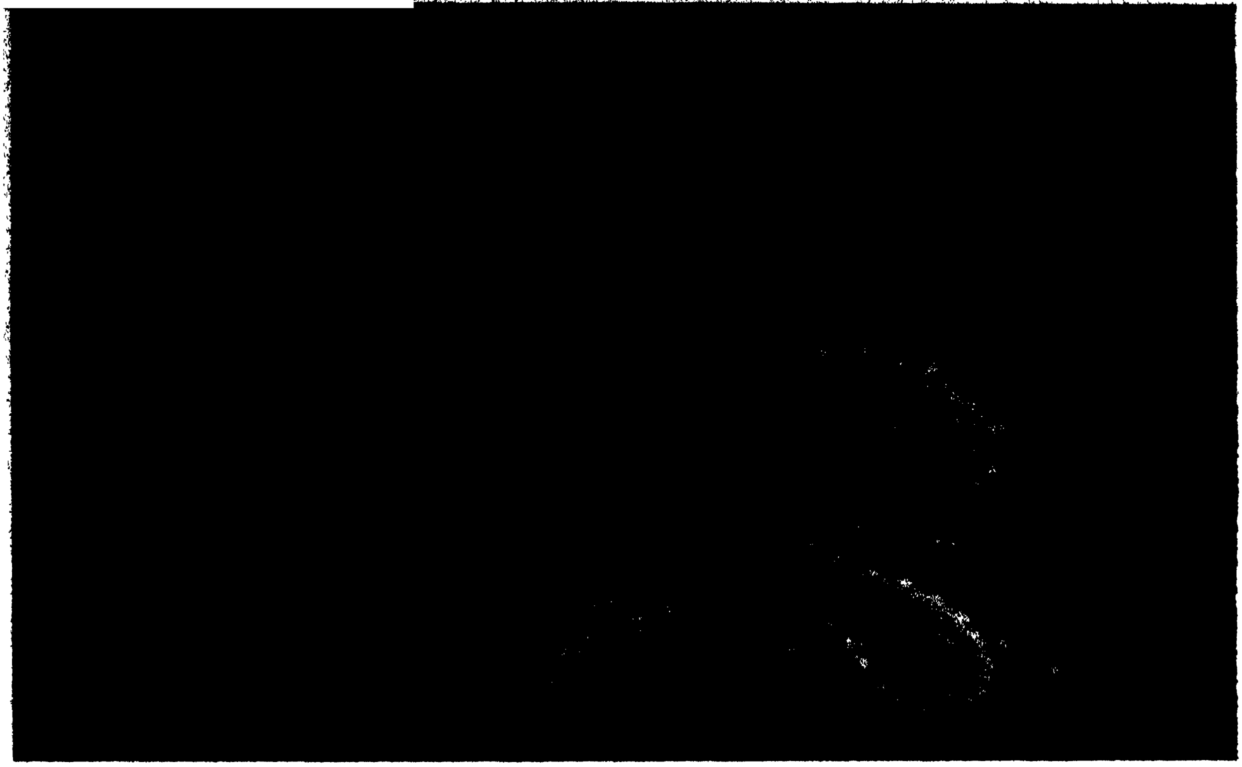
W. S Pitt

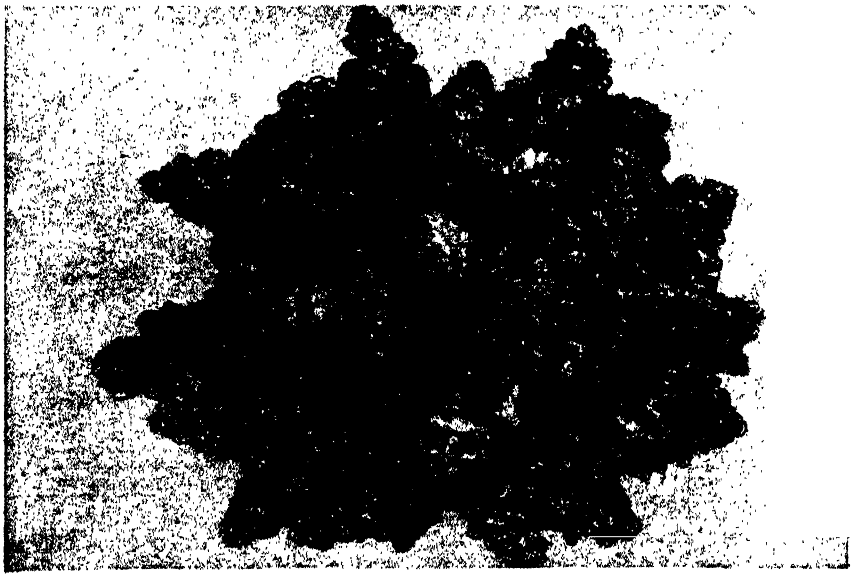
CARNIVOROUS TORTOISE WITH BEAK-LIKE JAWS

Although no tortoise has any teeth every individual has its jaws covered with horn so as to form a cutting beak These beaks can inflict dangerous bites Our photographs show a carnivorous tortoise that lives on worms Below we see the under side of the animal with its hinged shell which protects the head and tail Above is the tortoise on a worm hunt.

The Mammalia offer a great contrast to birds in this, as in other respects. Weapons of a purely defensive nature in the form of spines are found in the toothless spiny ant-eater or echidna of Australia, in the hedgehogs and some of their relatives in Madagascar, in some mice and in the porcupines where they attain their highest efficiency, and being exceedingly sharp and loosely attached often stick in the flesh of an incautious carnivore that attempts to prey on these animals, causing dangerous wounds. In the tree porcupines of America the spines, although short and slender, are barbed in such a way that, once detached, they work into the lips, tongue or paws of an enemy, sometimes with fatal results even to such large beasts as pumas. Tigers, too, have been killed by the long quills of the Indian ground porcupine penetrating to vital organs. The erectile horny plates of the scaly ant-eaters or pangolins come rather into the category of armour; but in some species where they carry marginal thorny points capable of pricking sharply they may be regarded as protective weapons. Purely protective also are the scent glands of the skunks and other members of the weasel tribe which discharge a volatile, suffocating fluid in the face of an attacking enemy—a method of defence like that of the spitting cobra and bombardier beetle.

The use of teeth as weapons for attack and defence is so general in mammals that it is exceptional for them not to be so employed. Occasionally it is the





W. Saville-Kent

CREATURES THAT KILL WITH THE HELP OF POISON AND SUCTION

One of the lowliest animals possessing weapons is this Australian sea anemone (bottom) which has numbers of stinging capsules, each containing a poisonous thread which is coiled up within and released by the stimulus of contact. With the poison the anemone can paralyse and kill the organisms on which it lives. Above is a squid, whose weapons are its huge sucking tentacles

chisel-like gnawing teeth, as in the rats, squirrels and other rodents, but usually it is the canines, as in the dogs, cats, weasels and other predatory carnivores, as well as in the monkeys. Teeth when enlarged and projecting beyond the lips are called tusks. They are associated with other teeth which are useless for fighting. A case in point is supplied by the huge upper canine tusks of the walrus which are primarily for digging up mussels and other shell-fish upon which this great seal mostly feeds, but also serve for killing larger prey, like other seals, and for self-defence as many a hunter has testified. The tusks of elephants are also uprooting instruments which act as weapons of attack and defence as well. Very efficient weapons, too, are the wild boars' tusks, formed by the upper and lower canines on each side, the lower being kept sharp by rubbing against the upper, which in the wild swine of the old world turn outwards and upwards. So deadly is the ripping power of these tusks that even tigers, it is said by hunters and naturalists, fear to attack a wild boar at bay.

The elephant and wild boar, with their specialised tusks, introduce us to a great group of vegetable feeding, mainly ungulate or hoofed mammals in which the teeth, modified for grazing or browsing, are in most cases functionless for fighting and are replaced for that purpose by horns or hoofs, sometimes both combined. But the camels and llamas still use their teeth for fighting. So also do horses,

F. Martin Duncan

DEADLY SCORPION WITH ITS POISONED DAGGER

Though very rarely causing death to an adult human being who is in good health, the scorpion's sting can inflict a serious wound. In the lower photograph we have the sting in detail, and greatly magnified. Above is a scorpion ready to sting

although their most efficient weapons are their solid-hoofed legs, fore and hind. The Asiatic rhinoceroses, too, despite their armature of nasal horns, always charge with the mouth, attempting to wound an opponent with the pair of small sharp tusks set in the fore part of the lower jaw. But the African rhinos, which have lost these tusks, are dependent upon their horns as weapons.

HORNS of another kind are found under a great variety of forms in the cattle, antelopes, sheep and goats, which never use their teeth. The horns may be short and sharp, as in many antelopes and the Indian wild goat or tahr ; or long, straight and spear-like, as in the gemsbok, which can transfix a charging lion ; or curved backwards, as in the sable antelope, so that the point inflicts a deep wound with a backward or upward sweep of the head. They are generally strengthened with ridges and often bent or twisted to lessen the shock to the skull from a direct blow ; and very frequently the use of the point is supplemented by the expansion of the base of the horn over the forehead to form a boss or casque which acts like a battering ram, as in the musk-ox and the big African buffalo, one of the most formidable animals in existence. The use of the horns as a battering ram is perfected in wild sheep which fight by charging head-on and striking an opponent with tremendous impact.

Almost as important as teeth and horns for attack and defence are the feet of mammals, whether terminated by claws, big nails or hoofs. In some hornless species, which cannot or do not bite, they are the only available weapons. Doe rabbits, with young, have been known to rout even stoats by leaping in the air and kicking them with their sharp clawed hind legs ; and hinds and hornless stags use their feet with great effect. A female prong-buck, indeed, has been known to lacerate a prairie wolf so severely with her hoofs that he abandoned the pursuit of the fawn he was after. Kangaroos when fighting raise themselves up and by using the tail and one leg as a support deliver rapid kicks with the other ; and the toothless great ant-eater, with his back to a tree and his defenceless snout tucked down against his breast, can beat off dogs and is said to be able to repel even a puma with the blows of his powerful fore-legs, armed with lacerating claws.

But commonly the feet are accessory weapons to horns or teeth. Elephants and buffaloes use them for trampling or kneeling on a prostrate foe ; and in carnivorous animals the paws are generally armed with claws of the greatest service in killing and fighting. The claws may be long and stout, as in the bears, which employ their fore-legs for striking an opponent, not for hugging as has often been said. But the most perfect claws for laceration are the sharp, hooked retractile claws of lions, tigers and others members of the cat tribe. Even the hands of monkeys must come into the category of weapons because they are used for holding an enemy before the teeth come into action. Baboons have been known to grip dogs by the head and rip the throat open with their great canine teeth, and gorillas are said to fell hunters with a blow of the hand.

The weapons hitherto considered are mainly those employed for the destruction of prey by predatory animals and for self-defence by the animals preyed upon, for warfare, that is to say, mostly between different species. But weapons sometimes serve more particularly the purpose of warfare between individuals of the same species, for the combats of the males for the possession of females. Some of these are alluded to in the chapter of this work dealing with Courtship Display Among the Animals. The subject, therefore, requires only brief notice here.

The tusks of elephants and wild boars, the canine teeth of monkeys and apes, and the horns of wild cattle, sheep, goats and many antelopes are larger in the males than the females. In some other antelopes horns are restricted to the males. Finally, in the deer which breed only once a year the horns or antlers are grown in readiness for that season, and are shed at the end of it. But a particularly significant point about antlers is that although stags engage in fierce combats for the hinds, these combats seldom end fatally, because the supernumerary branches act as guards against mutual injury and the fight resolves itself into a pushing contest from which the weaker individual disengages and makes his escape as soon as he realizes his inferiority.

Chapter CIX

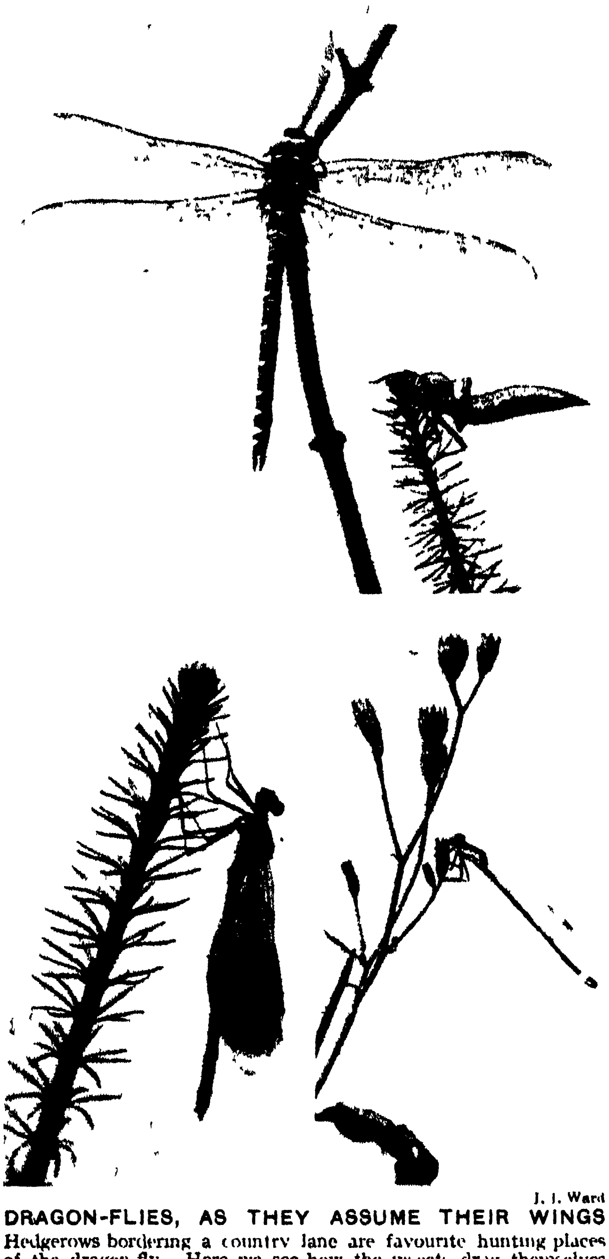
The Teeming Life of a Quiet Country Lane

By Frances Pitt

Author of "Wild Creatures of Garden and Hedgerow"

Passing along a country lane, all seems so still and quiet that no one would dream its hedge-banks were full of life; yet down in the tangled jungle of the wayside ditch, among the hedgerow plants of the fence, and even in the grass that borders the lane, are a host of creatures that live a life of gay adventure in the shadowy world among the undergrowth, from fierce hustling, bustling shrews to slow-moving snails.

Varied indeed is the wayside life of a quiet lane, the hedge-bank teems with spiders, grass-hoppers and caterpillars, with beetles, bees and wasps, with mice and even rats, to say nothing of birds, from the smart chaffinch, the demure whitethroat, the fussy wren, and the handsome greenfinch, to portly blackbirds and thrushes. And these are but a fraction of the creatures that haunt the wayside, a mere hint as to the real population that fills the world of hedge-bank and roadside herbage. When you peep and peer, and look carefully, you find that ditch and bank are tunnelled by highroads better used than the one on which we tread, these being the paths of the little people, who live in the shadowy depths of this miniature jungle, where existence runs fast and furious, where creatures more fierce than lion or tiger chase their prey, and adventure both gay and deadly lurks beneath the primrose leaves.



J. J. Ward

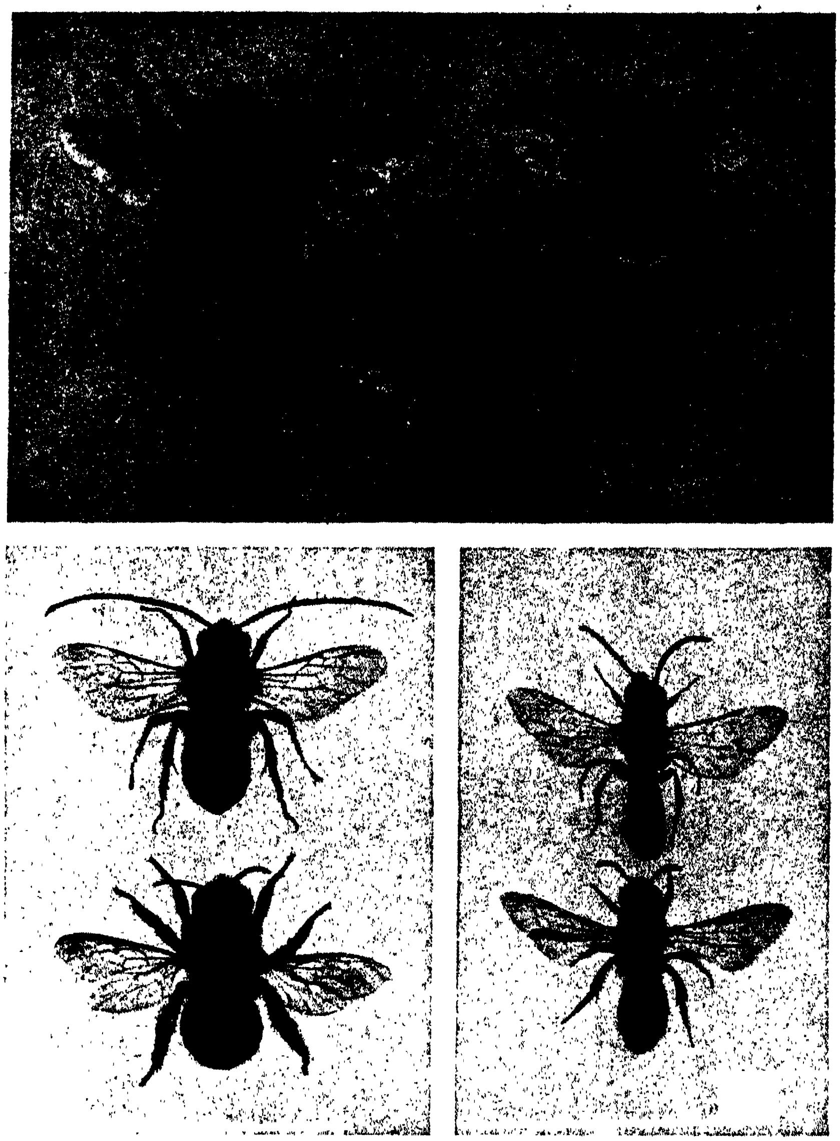
DRAGON-FLIES, AS THEY ASSUME THEIR WINGS

Hedgerows bordering a country lane are favourite hunting places of the dragon-fly. Here we see how the insects drag themselves out of their pupa skins (top) and dry themselves (bottom left). On the right (bottom) is an adult slender-bodied dragon-fly.

Now who and what are the inhabitants of the wayside jungle? First there are the mice; the sleek, smooth-coated, elegant long-tailed field-mouse, with great dark eyes, glistening like wet boot-buttons, its fawn coat, hand-like paws and dainty person; the bank vole, in red-brown, with a neat white waistcoat, and keen little face; and lastly the meadow vole, a rough-coated, short-tailed, plebeian-looking mouse; all of which haunt the hedge-bottom and ditch.

In the autumn you may find token of the long-tailed mouse in old birds' nests, for this mouse is no mean acrobat, and thinks nothing of going aloft, up into the thorn bushes and the briers, to raid the scarlet hips and haws, carrying each berry to some convenient dining-table, and there eating it at its leisure. Hence, as you walk along the road, you will see old birds' nests in the hedge filled to the brim with scarlet bits—this is where the long-tailed mouse feasted royally over night!

The two voles do not leave such obvious evidence of their presence, but now and again one may see a small brown shape dart across what, to it, must be the fearful arid expanse of the road. What nerves a bank, or meadow, vole to leave its home among the wayside grass, and face such a crossing? Probably the signal "danger!" has passed through the hedge-bank world. Considering their size, lions and tigers are timid beasts compared with the desperate hunters that haunt the seemingly peaceful ditch.



H. Bastin

WILD BEES THAT LIVE BY THE LANE SIDE

Many kinds of wild bees may be seen along the lane in summer. In the lower left hand photograph is a longhorn bee, a male above and a female below. Then we have (bottom right) a male and female of the *Halictus* family which live in burrows in the earth. The upper photograph is of a queen (left), drone (right) and worker (below) of a species of humble bee.

There is the weasel, a mighty Nimrod indeed, that is for ever hunting mice, voles and young rats, and races through their tunnels with relentless zeal. Slender, no bigger in girth than the mice it hunts, it passes like a fawn-coloured snake along their highways, to emerge for a moment upon the wayside and give one a fleeting glimpse of its dapper form. For a brief instant it sits up in a begging attitude, its little forepaws hanging folded in front of it, and its cream underparts exposed to the view, ere disappearing like the passing of a shadow into the tangled herbage.

Then there is its bigger relative the stoat, which is not only larger, but may always be known by its black-tipped tail (the weasel has *not* got a black "pencil") that comes to the lane after the rabbits which dwell in the hedgebanks. Here and there are rabbit burrows, where their owners live peaceably save when the dreaded stoat carries out a lightning raid.

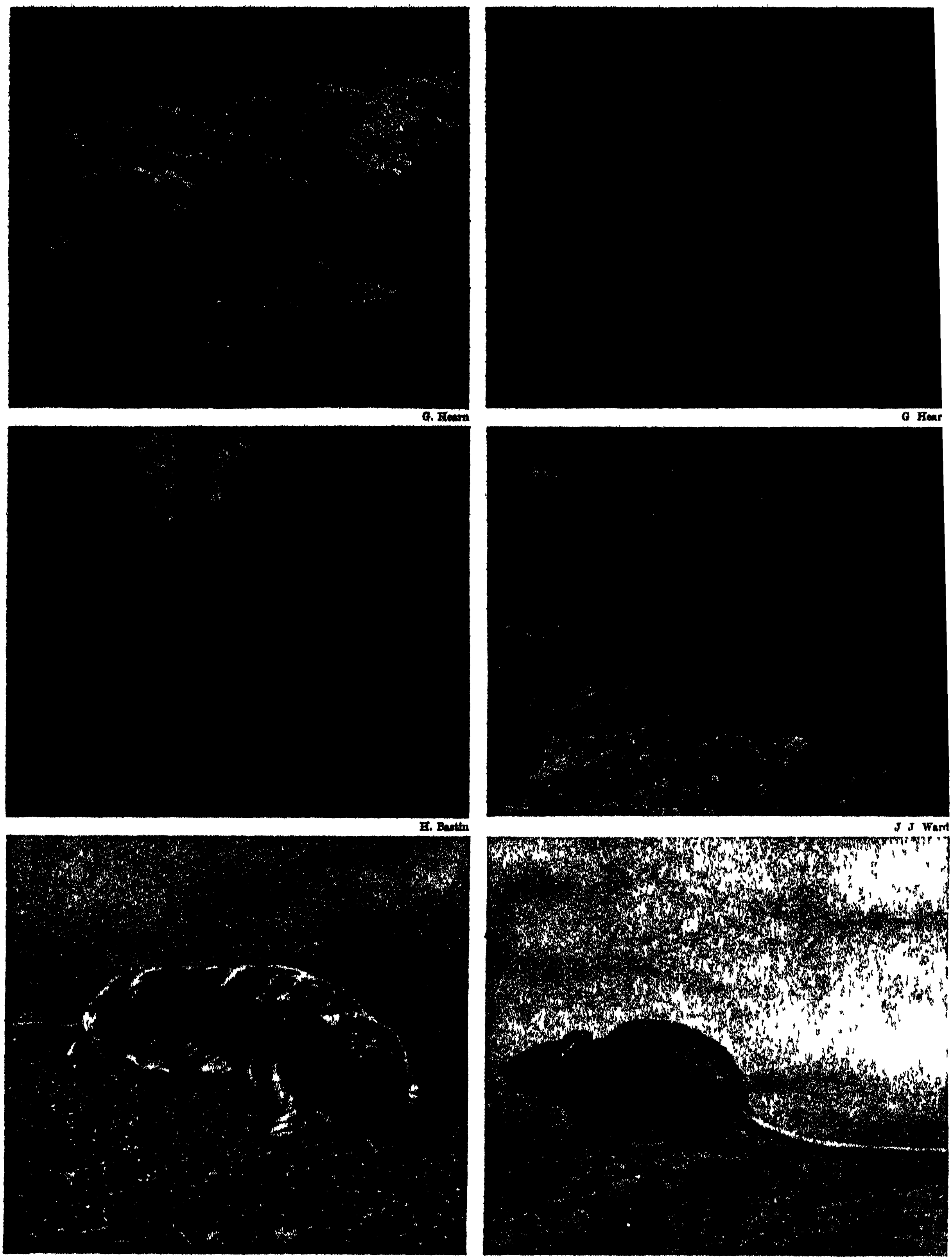
But hunt and be hunted is the lot of many of the inhabitants of the lane. Take the tiny shrews, as an example, that live in the grassy jungle and hunt the small things such as worms, insects and spiders with a fierce eagerness greater even than that of the weasel.

Shrews, though often spoken of as mice, are not rodents at all, but belong to the Insectivora, or insect-eating mammals, and live, as hinted above, upon quite different fare from that of real mice. They are hunters, though their game is small, but then so are they, and for their size they are wonderfully plucky. I have seen a pygmy shrew, not so big in girth as my little finger, spring upon an earth-worm, which to it must have been a squirming monster, larger than the legendary dragons of old, grab it and fairly worry it to death.

The pygmy, or lesser shrew, is one of the smallest of mammals, and is so wee that it is often overlooked and mistaken for a young common shrew.

The common shrew, which is the little creature frequently found lying dead in the roadway, is not a big beast either, but again it is indomitably plucky. I kept one in a cage once to study its habits, and the "mighty atom" knew no fear. If it did not get what it wanted, it would fly at my fingers and bite them like a fiend—luckily its teeth were very tiny.

The common shrew is one of the most numerous of the inhabitants of the wayside jungle, and as already mentioned, may often be found lying dead in the roadway. One reason for this is that it is an unpleasant-smelling little creature, and if a fox, dog, or cat, chances to kill one, it seldom eats it, but usually throws it away. Secondly, in the autumn shrews suffer from a mysterious mortality, dying off and being found lying dead on lanes and paths. In the days gone by it was thought that they were incapable of crossing a highway, but the modern



G. Hearn

G Hear

H. Bastin

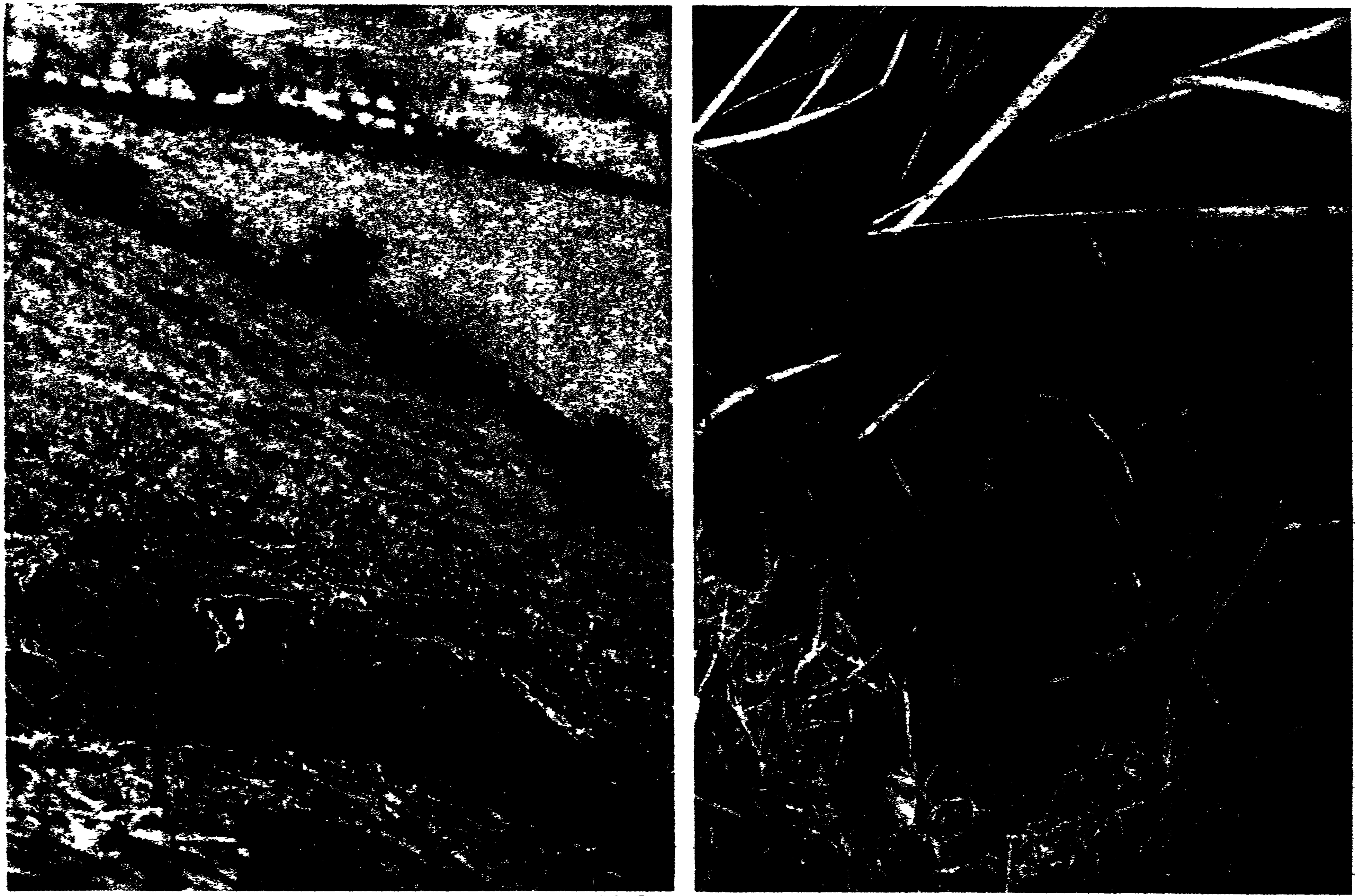
J J Ward

W S Berridge

W S. Berridge

SOME OF THE SMALL MAMMALS THAT LIVE IN THE HEDGE-BANKS

For those who have eyes to see it, the quiet country lane is busy with life and death, escape and capture. A soft progress down the lane will afford the best chance of seeing these larger inhabitants of the bank under the hedge. The mole (bottom left) is more often seen dead than alive, its appearance as a corpse before the wanderer's feet being not uncommon in the roadways in these days of fast-moving vehicles on rubber tyres. The rat, hedgehog, squirrel, and rabbit are all among the members of the lane's wild population.

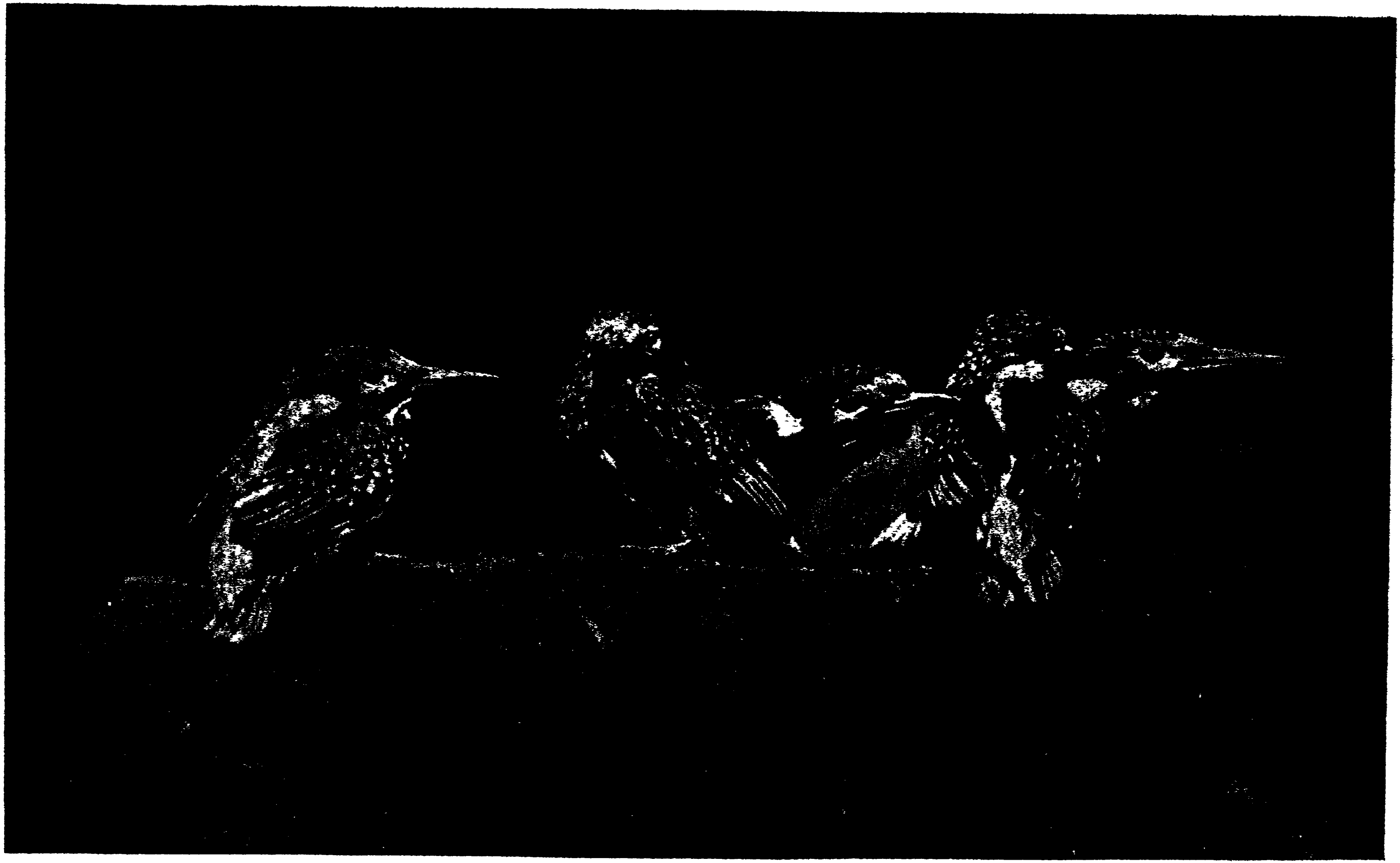


Arthur Brook

S. Crook

WILD CREATURES CAUGHT BY THE CAMERA BESIDE A COUNTRY LANE

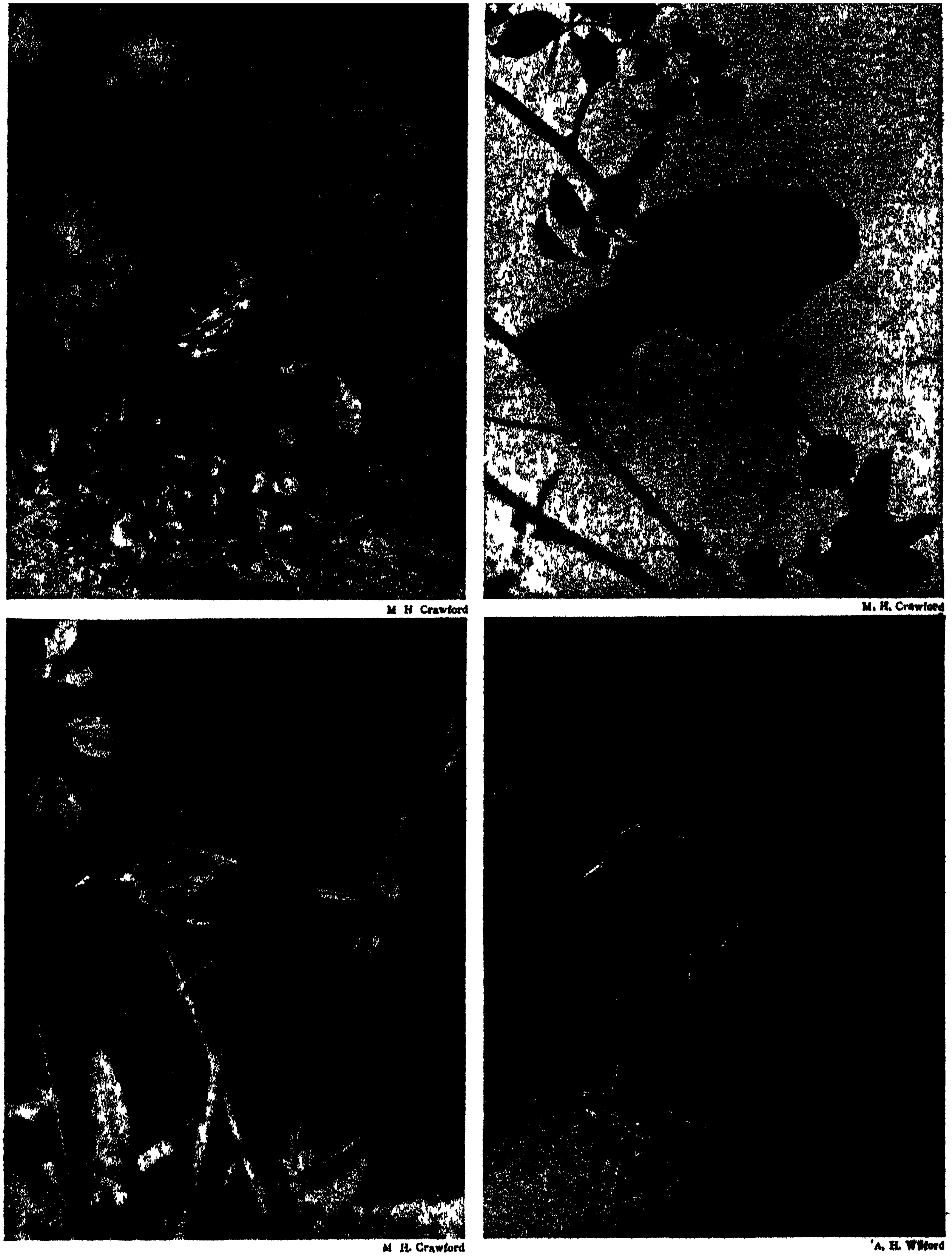
The country lane is, from the wild creature's point of view, merely an interruption in the countryside bordered by convenient cover in the shape of hedge or ditch, or fence or bank. Our left-hand illustration shows something that a cautious observer might see through a gap in the hedge, one fine evening It is a vixen at the mouth of her earth, situated in the hedgebank, looking cautiously round before deciding to start on her night's prowl for food The short-tailed field-mouse (right) is another of the dwellers in the bank beneath the hedge In this case the mother of a family has had her nest disturbed and is removing her progeny, one by one in her mouth, to new and undiscovered quarters.



Mondiale

WHERE THE BROOK COMES NEAR THE LANE: FAMILY OF YOUNG KINGFISHERS

Easiest to see of all the lane's inhabitants are the many birds that have their homes and hunt for food there. Thrush, yellow-hammer and hedge sparrow catch our eye as we walk on summer mornings along some country way which still knows more of horse's hoofs than the wheels of motor cars. Where the lane goes through the brook by a watersplash, or over it by some old bridge, we may chance to get the dazzling, bright blue glint of a kingfisher's feathers as the bird flashes up stream to its fishing. Here we see a family of young kingfishers, sunning themselves on a rock. The young birds are always paler and less brilliant than their parents and their bills are all black, whereas those of the older birds have orange at the base.



M H Crawford

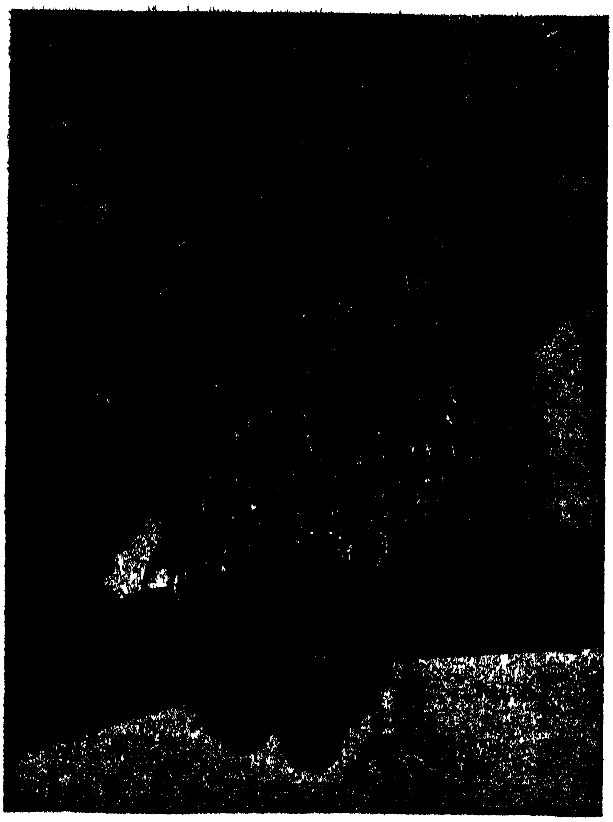
M. H. Crawford

M H. Crawford

A. H. Willford

BIRDS OF THE WAYSIDE. WILLOW WARBLER, WREN, THRUSH AND GREAT TIT

Life in the lane is as intricate and interwoven as the grasses and the boughs that grow beside the way. Below (bottom left) we have a male willow warbler which has just caught sight of a grub on a branch below and is deciding whether or no it is good eating Another lane side bird is the brown wren (bottom right). Sometimes a flint, kicked up by a passing cart horse, serves as a convenient anvil on which a thrush can smash the shells of snails to which it is very partial (top left) The upper right-hand photograph is of a great tit.



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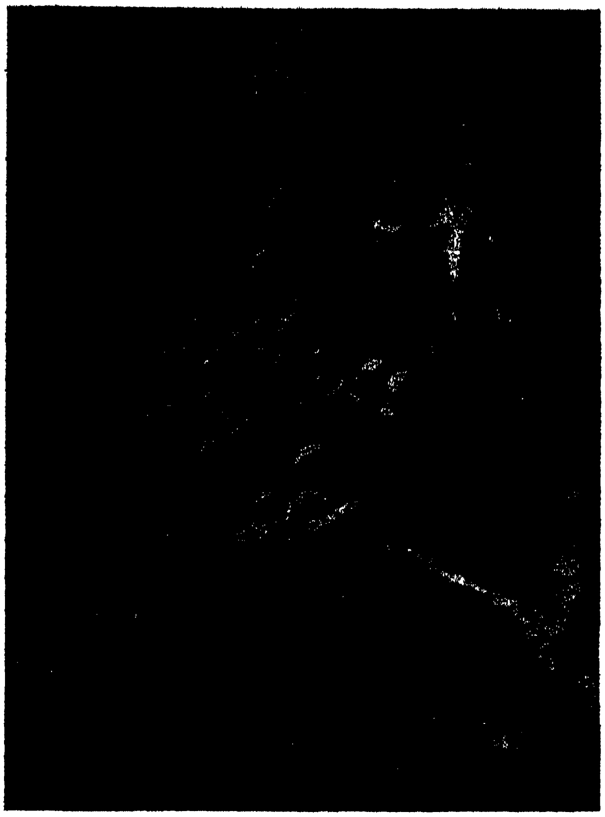


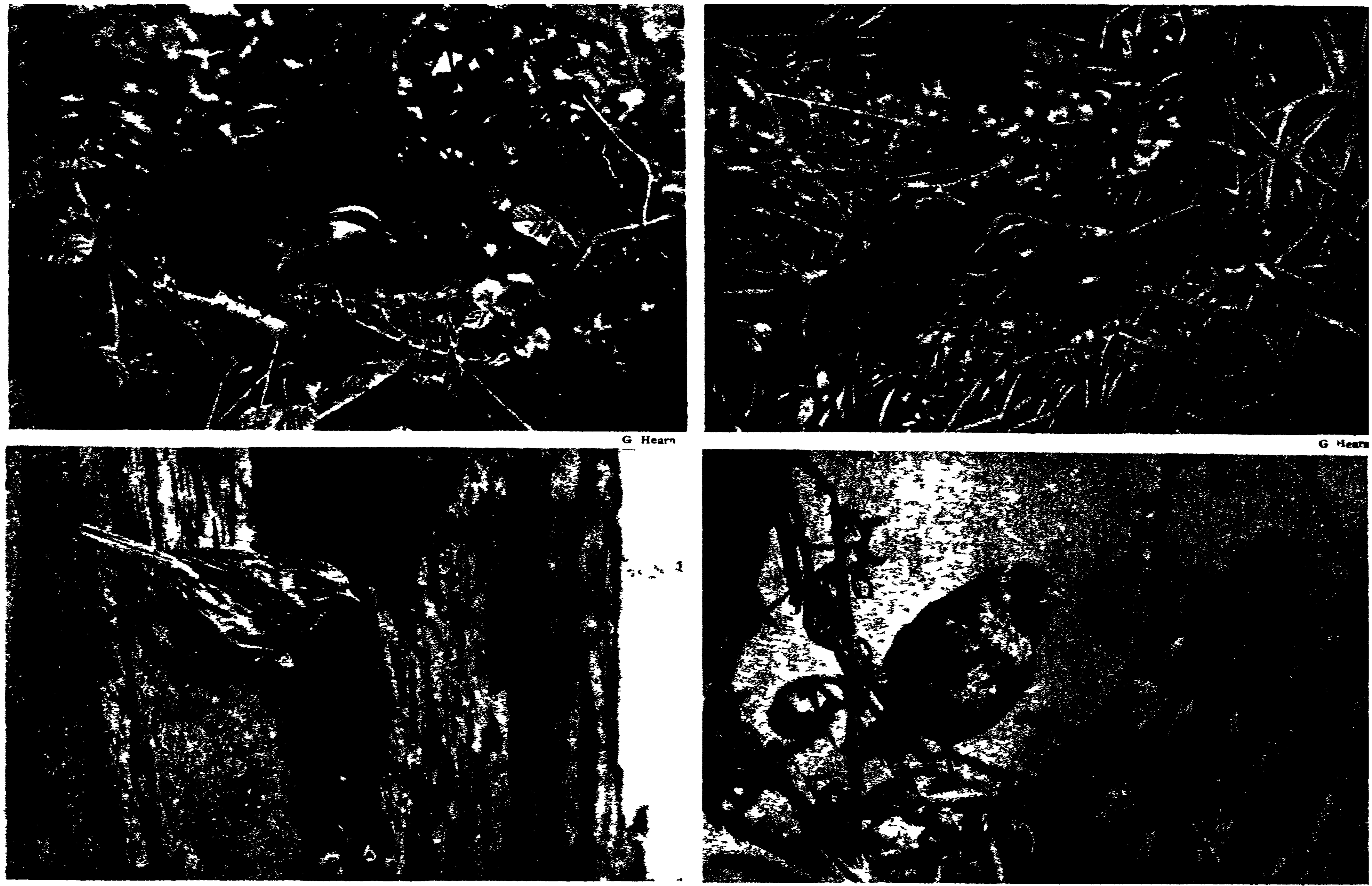
I. T Roberts

M. H. Crawford

M. H. Crawford

THREE WINGED PIRATES OF THE EVENING AND A WINTER SINGER

Discrepancies in size between some of the hunters and their prey which play hide and seek for dear life—on both sides—among the hedges are enormous. The big barn owl (bottom left), coming like an ill omen over the meadow at dusk, feeds largely on field mice, among the smallest of the lane's creatures. The brown owl (top left) and the little owl (top right) are two other hunters of the hedgeside and the latter, an imported species, is on the increase. By contrast to all this, the robin (bottom right) sings us a cheerful song on a winter's day.



G. Hearn

G. Hearn

G. Hearn

M. H. Crawford

HEDGE SPARROW, GOLDFINCH, BUTCHER BIRD AND WILLOW WREN, COMPANIONS ON A COUNTRY WALK

Soberly clad but pretty to watch is the hedge sparrow (bottom left) which does not belong to the same avian family as the common house sparrow and can be readily distinguished from the latter by its smaller size, neater appearance and the absence of a white bar on the wing This one is just going to its nest in a tree in the hedge. The goldfinch (bottom right) is a little smaller than the hedge sparrow and may be seen where the lane goes past a copse or through woods. It is a great eater of the seeds of weeds and in this respect a friend of the gardener The red-backed shrike (top left) or butcher bird makes the hedge into a larder, spitting its prey on thorns near its nest It is shown with a stolen egg in its beak. On the right (top) is a willow wren.

Life of a Country Lane

P Webster

HOUSE MARTINS ON THE BEAM OF A BARN ROOF

As we pass a barn or a farm house there may fly out two or three birds which a townsman might mistake for swallows. But their glossy black heads and the white patches on their backs at the base of their tails show them to be house martins. The swallow's head is chestnut brown, and there is no white patch on the back. The house martin lives exclusively on insects and is therefore a great boon to cultivation. Unfortunately it is often driven from its nest by the house sparrow which, when adult, is almost entirely a seed eater in rural districts

theory is that they are like annual plants, the old ones dying off in the autumn after rearing their young ones.

Other inhabitants of the wayside ditch are the toad and the frog, who during the day keep to its dampest recesses, but come hopping forth at dusk, even into the roadway, on hunting and adventure bent, for even these quiet, unobtrusive creatures are hunters, their quarry being likewise insects

THE fact of the matter is that the wild life of a quiet English lane is an epitome of Nature in the outer wilds, every creature being part of an interwoven net of life, one dependent on another, each complementary to its fellows, the frogs and toads, shrews and weasels, and the hundred and one other creatures, having their part in the Balance of Nature, and so keeping each species in its place and preventing its increasing unduly.

The frog eats insects and grubs, but gliding along the mouse runs comes the grass snake, which has a liking for frogs. In some parts of Great Britain the adder may also be found on the wayside, but in my experience " vipers " are usually nothing of the sort! It is the harmless blindworm that more often than not gets the credit of being a " dangerous snake." The blindworm is not only quite inoffensive to everything bigger than small earthworms and such lesser fry, but is not really a snake at all, being a legless lizard. As a rule it lurks in the green depths of the wayside tangle, under the shade of hedge parsley, " lords and ladies," and the scores of competing plants, but when the sun shines it comes out to enjoy the warmth, and it will perhaps be found sunning itself in the lane.

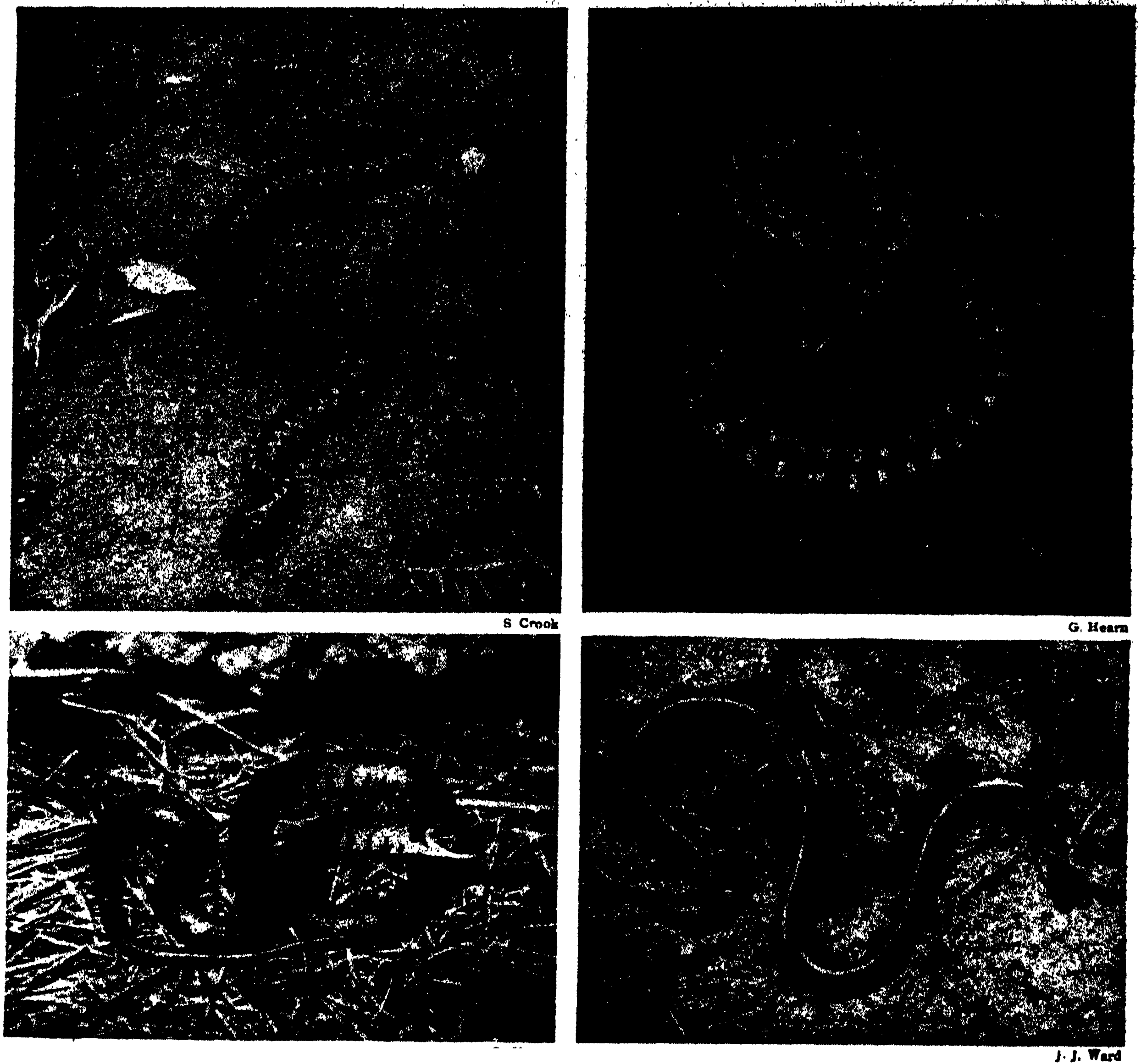
Apropos of shrews, frogs and blindworms, what of the tiny things on which they live? These indeed throng the wayside, and what a varied horde they are. There are the tiny scarlet black-spotted froghoppers that disport themselves each summer day on the wayside herbage, while active green tiger beetles dash about on the dusty road; there are ladybird beetles in their well-known uniform, the dingy click-beetle, parent of the destructive wireworm, and many another.

At dusk, when the " flittermouse " (the country folk use this term indifferently for the pipistrelle and whiskered bats) comes fluttering up the lane, to wheel, turn and twist on rustling skinny wings about the wayside bushes, certain mysterious fairy lamps are lit down among the grass. Little phosphorescent greenish lights appear, the night lights of the glow-worm, that little female beetle's equivalent of the dazzling signs that flash advertisements into our great towns' darkness, which are likewise an advertisement, and a matrimonial one at that. The female glow-worm, though a beetle, is unable to fly, but her mate has retained his wings, and uses them to seek his lady-love, flying through the summer night in search of her beckoning light.

We may divide the population of a country lane into the day world and the night world, for a host of hidden creatures come forth as the twilight descends. Not only are there the fluttering bats, but dor beetles hum past like heavy engined aeroplanes winging their way into the night, and moths appear as if by magic. The pallid ghost moth dances over the wayside grass, other soft-winged insects brush against one's face, mice scuttle with rustling steps in the hedge-banks, and a ponderous toad adventures forth upon the dangerous roadway.

The lane at night is full of life; if the creatures of the day have gone to rest, the creatures of the night are up and about, and they hold high revels until the sun rises once more, when rabbits seek their burrows, the toad its retreat in the ditch, the mice their holes in the bank, and the fluttering moths sink into the herbage or alight on palings, tree trunks or posts, where they draw their cloak of invisibility about them and vanish from sight.

Take the buff-tip moth (*Phalera bucephala*) as an example, which when it closes its wings loses all



S Crook

G. Hearn

J. J. Ward

TWO SNAKES AND A LIZARD THAT HAS LOST ITS LEGS

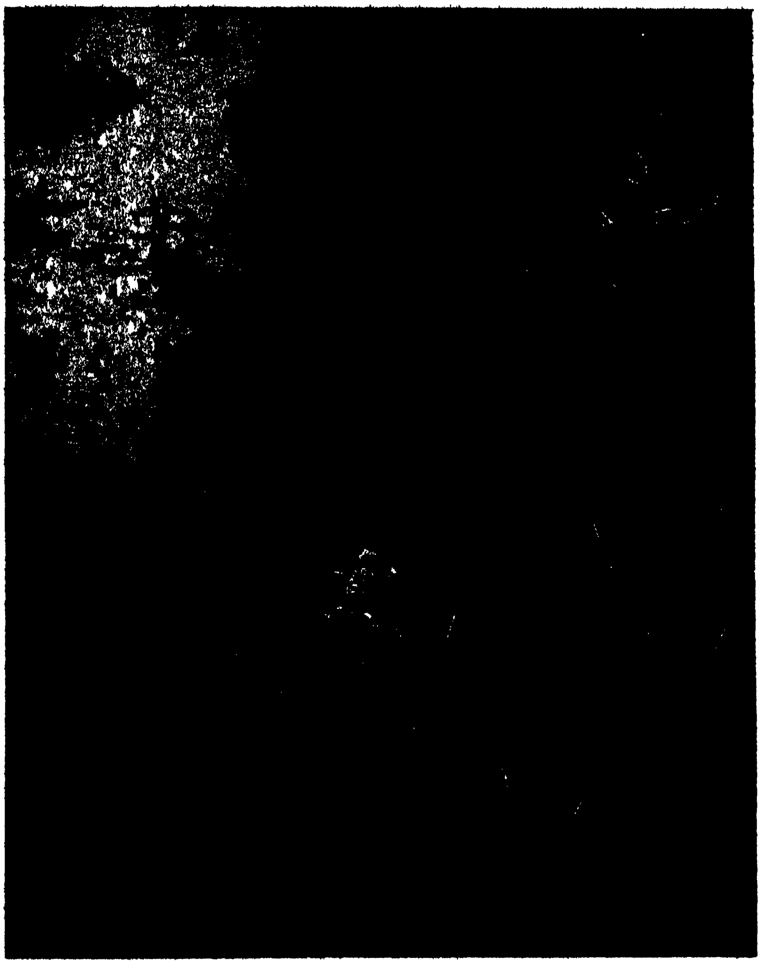
In the byeways of English counties snakes are not often seen, though they often hunt the ditches and the tall grass for their food. The grass snake (bottom left) and the slow worm (bottom right) the last not a snake but a legless lizard, are often killed on sight, though they are entirely harmless. The viper or adder (top), distinguished by the "V" mark on its head and the zig-zag line down its back, is venomous, though seldom fatally so. It sometimes comes on to the road for a sun bath, but will always rather flee than fight a human being.

resemblance to an insect and takes on the appearance of a bit of broken stick; or the angle shades (*Phlogophora meticulosa*), that as it rests among the wayside plants becomes nothing but a dry, crumpled leaf.

But the boldest camouflage is that of the clouded magpie moth (*Abraxa ssylvata*), which does not try to hide, merely taking the first resting-place that it meets with and seating itself there with outspread wings, that make a white patch slightly specked with grey and amber, so that the moth loses all semblance of an insect and looks just like the casual dropping of some bird.

Then in considering the insect life of the lane, there are the caterpillars, from the slender stick-like larvae of the Geometridae to the fine, furry caterpillars of the tiger moth, the drinker and others. Not one is more conspicuous than the social larva of the buff-tip moth, which in company with some scores of its fellows, strips the leaves mercilessly from the nut bushes.

The fact of the matter is that the lane with its fences is an entomologist's paradise, where everything that creeps, crawls and flies may be met with. It is here that the earliest of the spring butterflies appear, orange-tips, brimstones and cabbage whites, and where later in the summer gauzy dragon-flies wheel, turn and dart, in company with gorgeous peacock butterflies, red admirals and painted ladies; while bees, from the ponderous bumble bee to the various tiny solitary bees, buzz about their business. There are lacewing flies, hover-flies, and countless others, there are wasps, with a paper nest hanging in the fence (*Vespa sylvestris*), and the common wasps with their nest in the roadside bank; while of spiders there are great numbers—wolf spiders racing through and over the grass, carrying their family cares behind them, bearing their cocoon of eggs attached to their spinnerets, and great fat orb-weavers sitting motionless but alert near their snares spun on the fence.



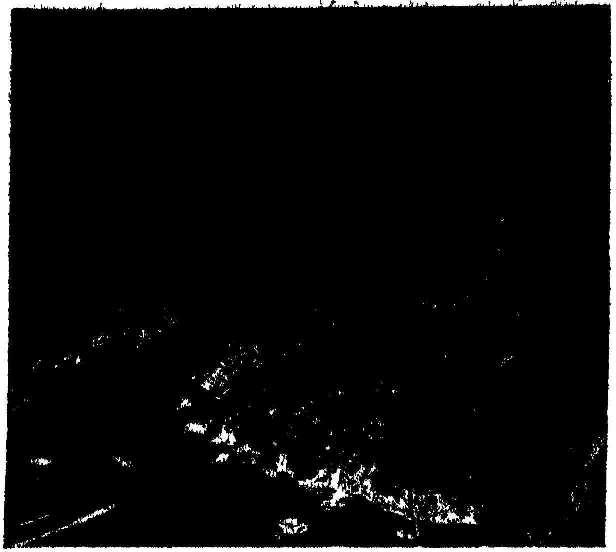
S Crook

NATTERJACK AND COMMON TOADS BY THE WAY

Natterjacks are rare toads, but are occasionally to be found among the grass at the side of the road. Here we have a fine specimen (bottom). The common toad is a familiar discovery, especially in damp surroundings. Sometimes a dead one may be found crushed in the road. This one (top) is thinking over the next meal beside a clump of rushes by a pond.

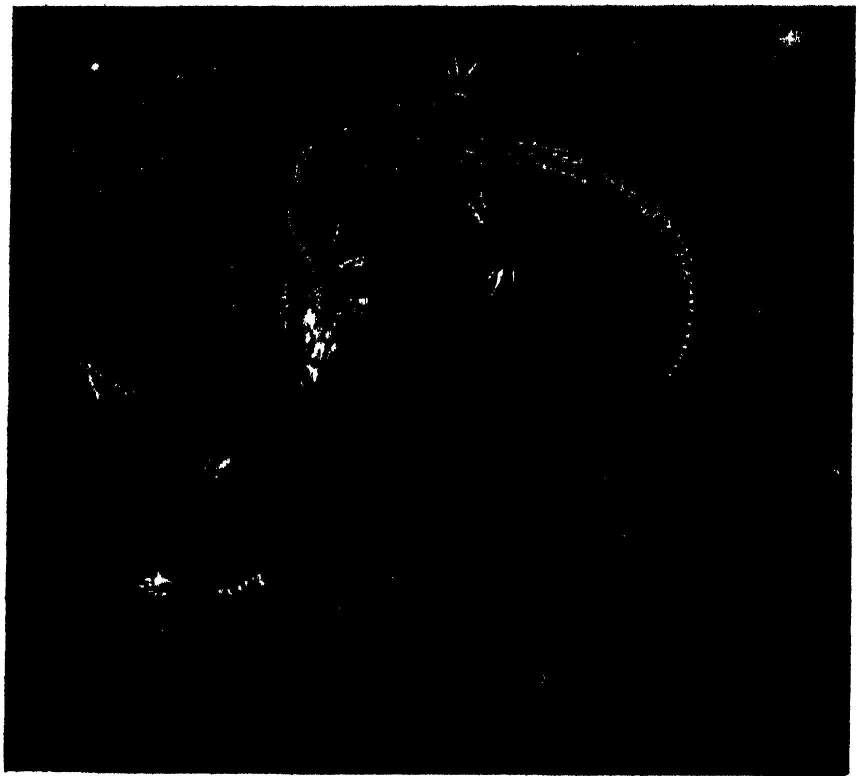
A book could be written upon the spiders of a country lane, on the orb-weavers, sheet-weavers and others, but the reader will have to go and discover the many kinds for himself, because one of the most important sections of the population of the wayside has been neglected, and space is running short. I mean the birds. Bird-life looms large in our country lane. Partridges and larks come from the nearby fields to enjoy the luxury of a sand bath at its dusty side, and other birds seize the opportunity afforded by a shower to wash in the rain puddles. I have often seen chaffinches and blackbirds splashing water far and wide, bathing in the middle of the track in a manner they could not have done on a well-used highway, where roaring motors would speedily have sent them about their business. Our quiet lane, however, is but little worried by noisy traffic, and birds nest happily in its straggling fences. The aforesaid chaffinch commonly makes its neat cup of moss and lichen in the thorn hedge, lays its purple-streaked eggs therein, and broods there in happy indifference to passers-by.

The yellow-hammer is another bird that loves the lane, and, what is more, is one of its most noticeable inhabitants. This is not because it is a noisy or conspicuous bird, but it has the habit of sitting on the topmost twig of a bush, or the telegraph wires if there are any, and from this vantage spot saying persistently " little bit of bread and *no* cheese ! " Even if the smart yellow



S. Crook

S. Crook



J. J. Ward

LIZARD, NEWT AND FROG BY THE ROADSIDE POND

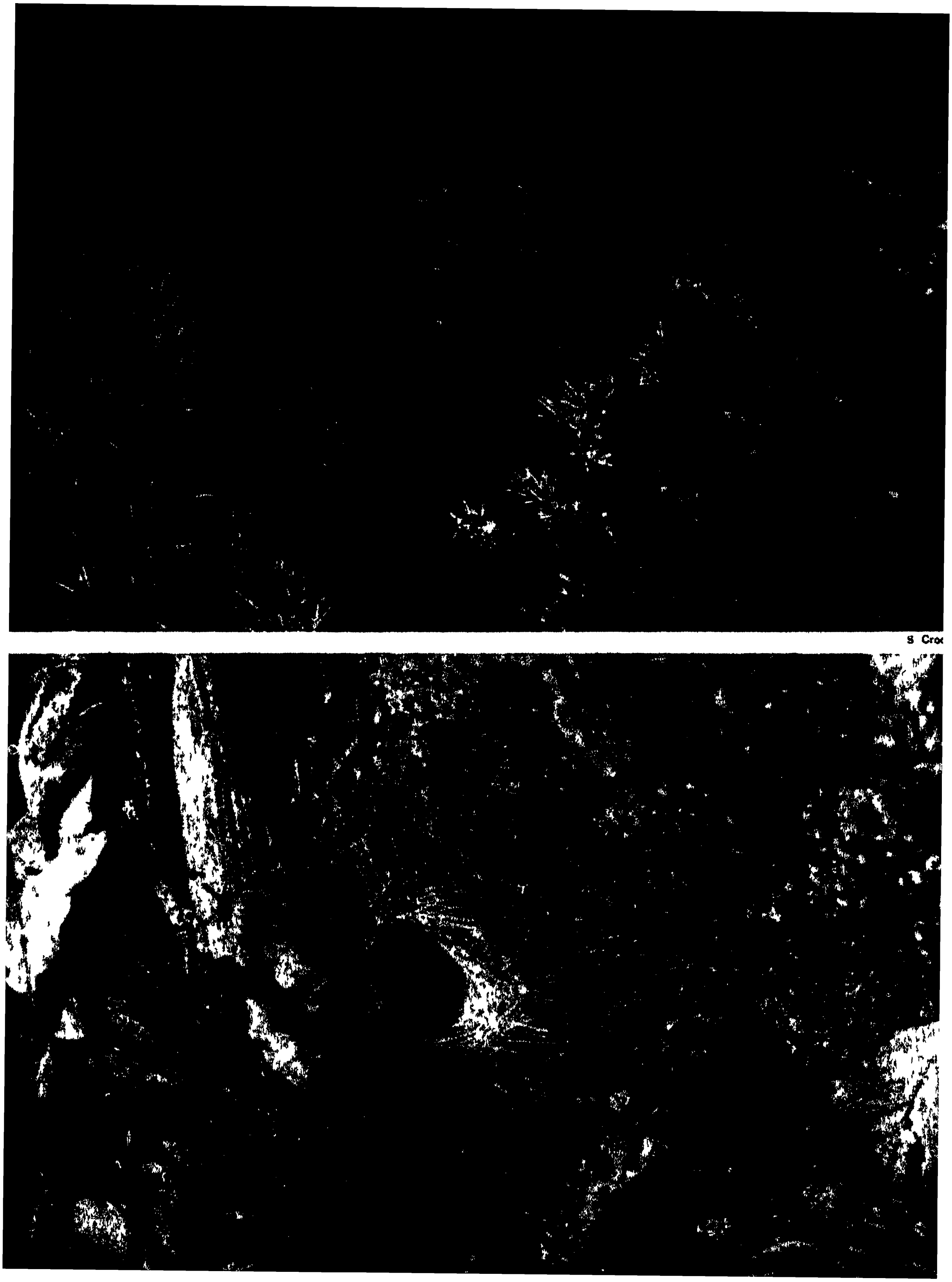
A pause by the roadside pond will reveal another little world of absorbingly interesting life. By the stones on the margin of the pond we may find a lizard (bottom) stalking some new hatched fly that has just left the water on its first flight. Or some newts may put in an appearance (top left) if the watcher keeps quiet enough, or a frog in its bright uniform (top right).

waistcoat of the yellow-hammer (otherwise yellow bunting, was not sufficient to identify it, that oft-repeated phrase is unmistakeable Wires are a favourite perch with many of the birds of the lane, and one may see birds of all sorts and descriptions taking the air upon them

One morning I had a splendid view of a cock butcher bird (red-backed shrike) sitting aloft, the sun shining on his grey head, reddish back and the dark markings on either side of his beak which looked just like a black moustache. A very smart fellow he was, but I looked in vain for his larder, yet it was probably somewhere near. The butcher bird is a creature of catholic tastes, ready to pounce on anything from small insects up to the callow nestlings of its fellow hedgerow birds, but it is also of a provident nature, and acts on the principle of "waste not, want not," hence somewhere near its headquarters, somewhere in the neighbourhood of its nest, it has a larder, a thorn bush with spikes, whereon it hangs its provisions. Here you will find bumble bees, beetles, mice and even, as said above, nestling birds, impaled on the thorns, being hung there until required by their owner. No wonder this shrike is usually known as the "butcher bird."

To return to the yellow-hammer, its nest must be sought in the low-growing tangle of the hedgebank, where the dainty white-throat, or as the children call it, the nettle-creeper, also weaves its fragile cradle, often as its country name denotes in a protective bed of nettles.

Then what of the familiar robin ? It, of course, is to be found down the lane, and in the spring time each pair appropriate a certain length of it to their own use, no other robins being allowed to

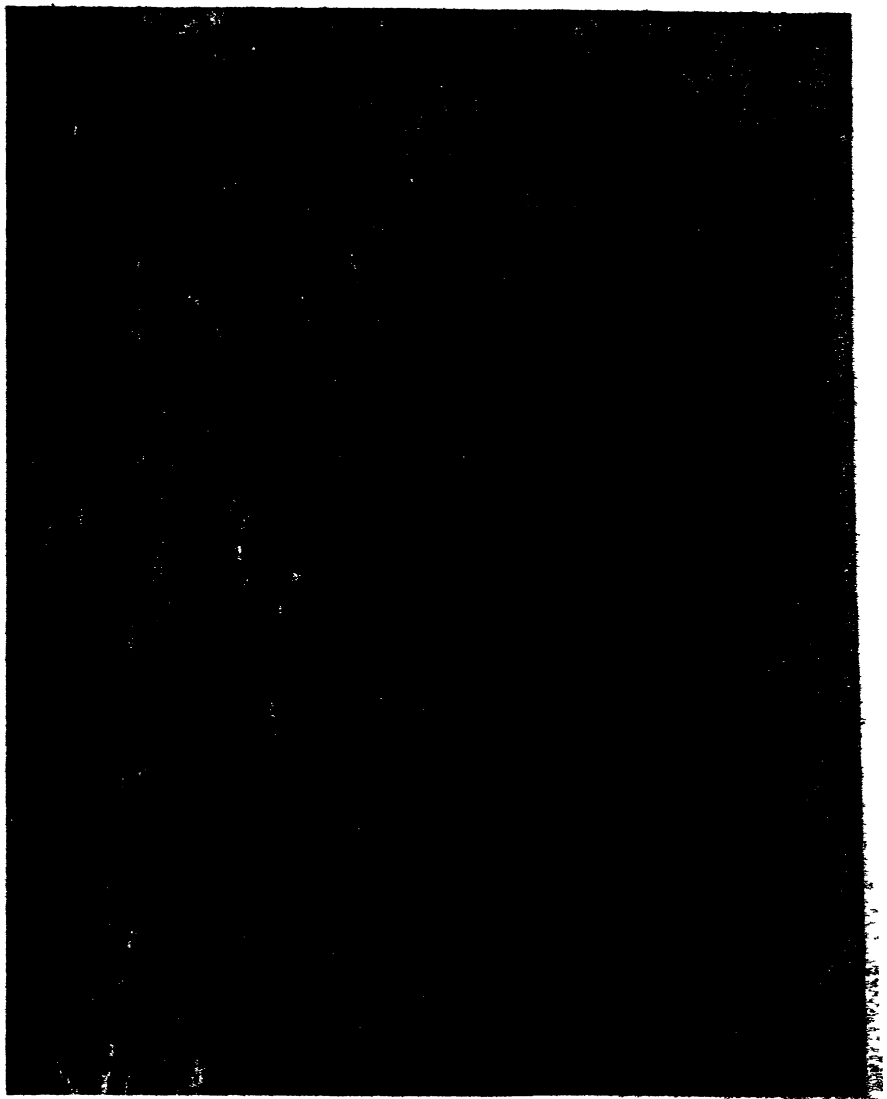


S Cro

CLEVER THREAD SPINNERS THAT LIE IN WAIT FOR PASSING PREY

So many different creatures live in the lane that we cannot hope to see more than a tithe of them at any one time. The large inhabitants—stoats, rabbits, and weasels—are usually more hidden from our eyes than the smaller, and, of course, are not so numerous. One may find ten spiders before seeing a single hedgehog The wolf spider (bottom) makes a gossamer house as we see, and lurks inside waiting to rush out upon any passing insect it may care to tackle. Above is the familiar wheel-like trap of a web-spinning spider.

H Bastin



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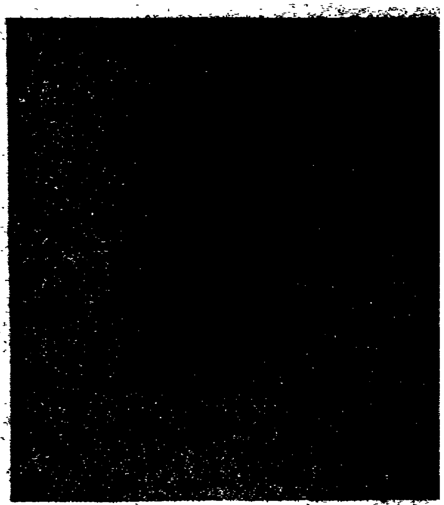
AN ANT COLONY BENEATH A STONE: SIGNS THE ELM BARK BEETLE MAKES ON WOOD

If we sit down incautiously on a bank under the hedge we may find, to our cost, that we have intruded upon an ants' nest Our photograph shows part of a community of brown garden ants upon the stone under which they have chosen to construct their city A peep under the stone will reveal a continuous and apparently aimless running to and fro of hundreds of tiny citizens. Yet each has his task and is doing it. On the right we see the marks made by a family of elm bark beetles. The mother makes a central burrow, lays a row of eggs in it and, when the grubs hatch they bore tunnels outwards feeding as they go, marking the wood with these strange patterns as we see.

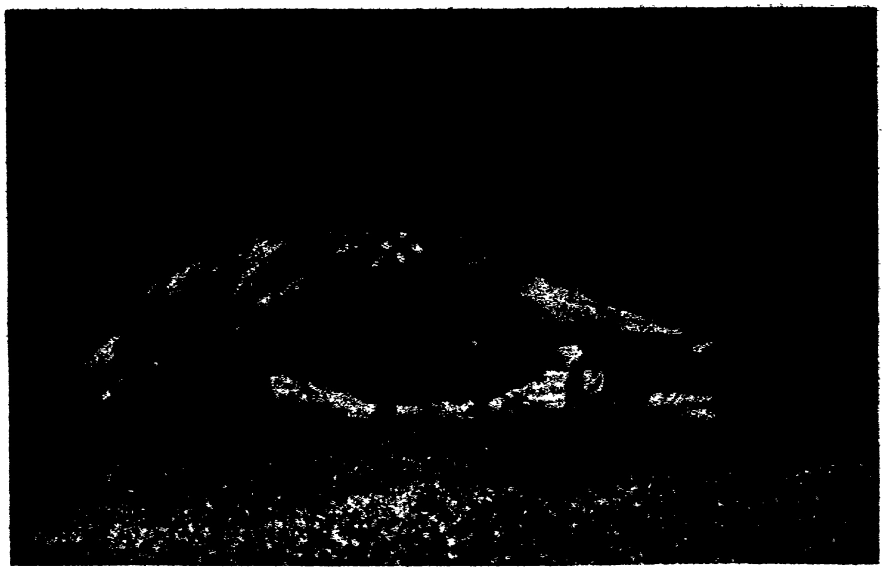
Musk beetle

Male stag beetles fighting



Common dor beetle

Violet ground beetle

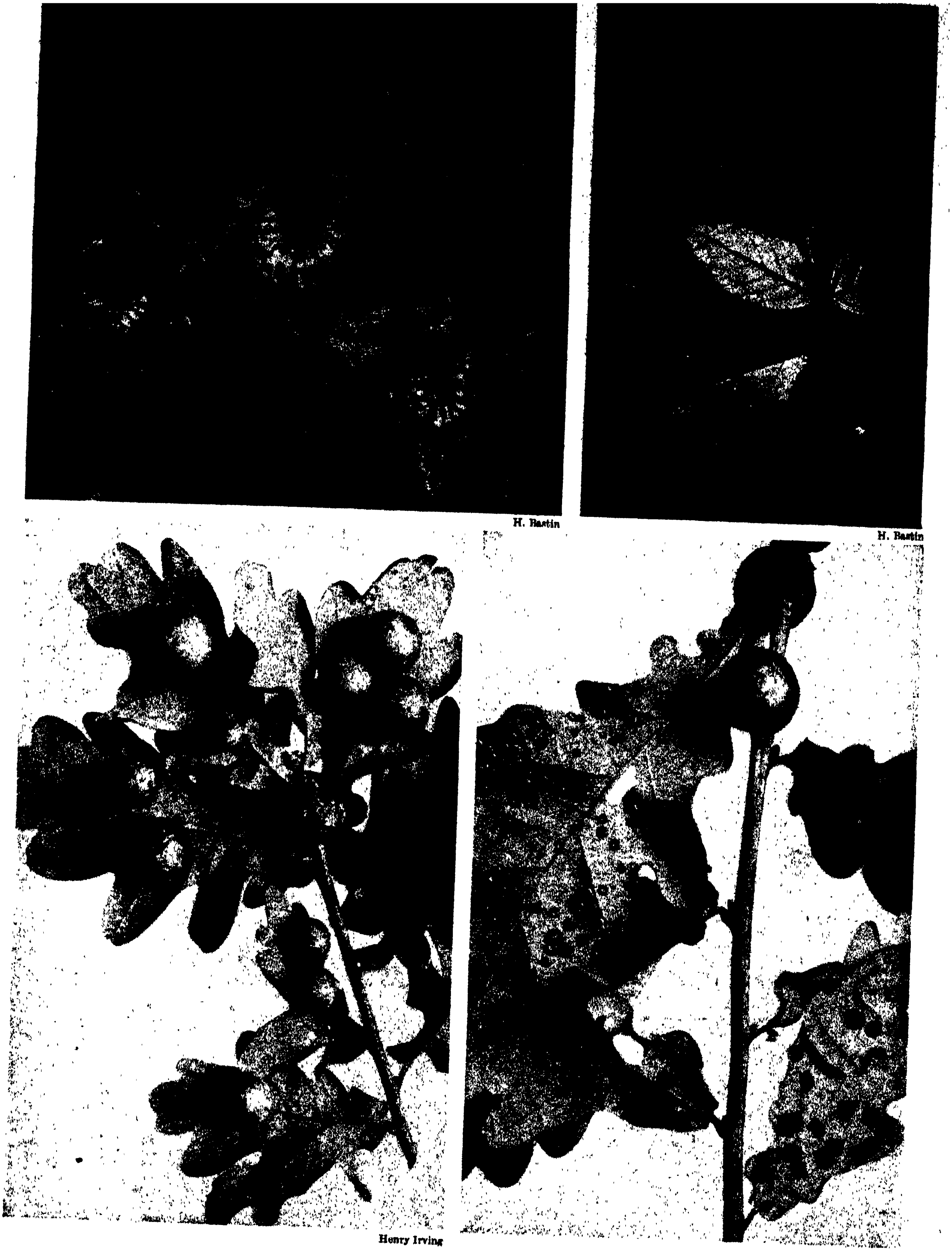


Burying beetles about to bury a linnet

Ground beetle

GROUND BEETLES THAT ATTACK ROOT EATING GRUBS, AND THE ANTLERED STAG BEETLE

Scuttling off among the grass-stems or perhaps hurrying apprehensively across the roadway before our feet we may chance to see one of the numerous ground beetles of which there are over three hundred species in Great Britain. For the most part these beetles are the friends of the farmer, for they spend most of their life underground hunting for the grubs which destroy the roots of plants. The violet ground beetle (bottom left) is one of these. It is shiny black in colour but has a violet sheen upon it. Burying beetles (bottom centre) act as sanitary officers in removing decaying bodies and the male stag beetles (top centre) may entertain us in their mating season by a battle with their formidable looking antlers. Photos by H. Bastin and J. F. Corrigan



H. Bastin

H. Bastin

Henry Irving

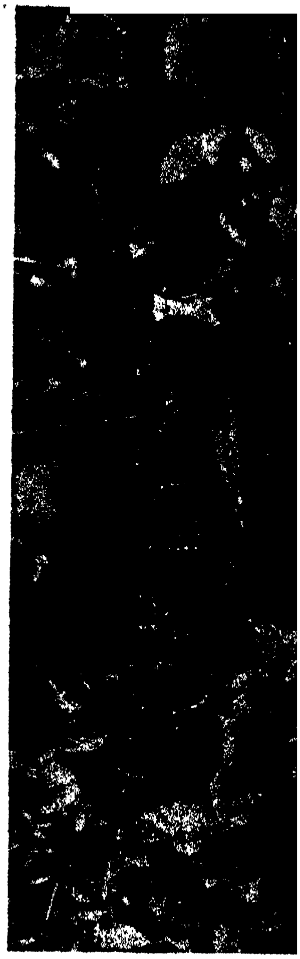
H. Bastin

STRANGE WORK OF THE GALLS ON TREE AND PLANT

Here we have some of the minute life to be found in our country lane. It does not force itself upon the attention as the larger and active forms of life do. Galls on plants are formed by the action of various grubs. The oak leaf is liable to suffer from cherry galls (bottom left), while it may also be attacked (bottom right) by the silk button (left) and spangle (right) as well as suffering from marble galls on the twig between the leaves. Above are (top left) the inside of a bedeguar gall magnified, and (top right) the same gall on a rose.

Crimson underwing larvae

Poplar hawk moth caterpillars



Lackey moth larvae

Death's-head moth larva, the largest British caterpillar

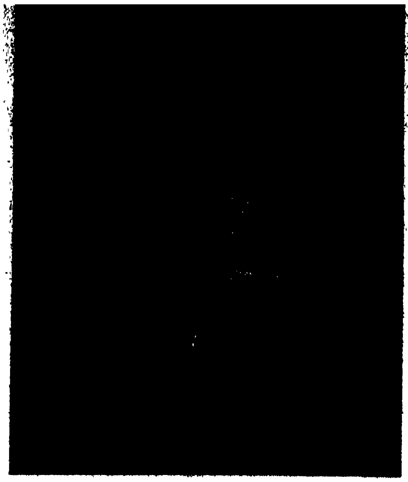
Goat moth caterpillars

MOTH CATERPILLARS FOUND IN THEIR HIDING PLACES

If we come across a large caterpillar about five inches long, with transverse bars of purple brown, we know we have found the largest British caterpillar (bottom left), that of the death's-head moth. The general colour is usually green or greenish yellow, but some specimens are brown or nearly black. An odour as of a he-goat may assault our noses and betray the presence of the caterpillar of a goat moth Above are caterpillars of the crimson underwing (top left), poplar hawk moth (centre) and lackey moth (top right). Photos by H. Bastin and J. J. Ward.

BUTTERFLIES THAT SPEND THEIR LIVES IN SUMMER SUNSHINE J. J. Ward

Rivalling the flowers in brilliance the butterflies will attract the attention of the most casual observer. A common and very beautiful butterfly is the red admiral (lower illustrations), whose caterpillars live on stinging nettle plants. The mottling of white above the crimson bands helps to make this brilliance less conspicuous The silver washed fritillary (top left) has the typical fritillary spots on the upper sides of its wings but the under sides are relieved with a silvery tint The chalk hill blue (top right) is usually to be seen in downland districts.



Plume moth

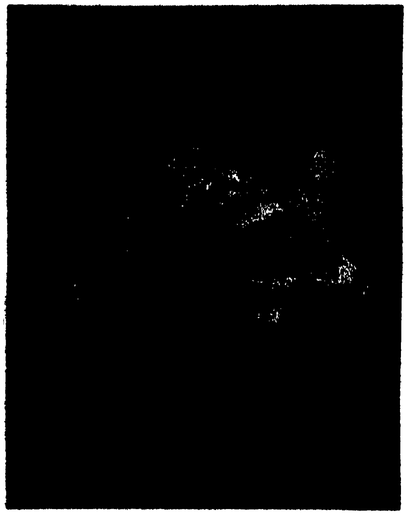
Common tiger moth

Scarlet tiger moths

Mottled umber moth

Eyed hawk moth

Eyed hawk moth



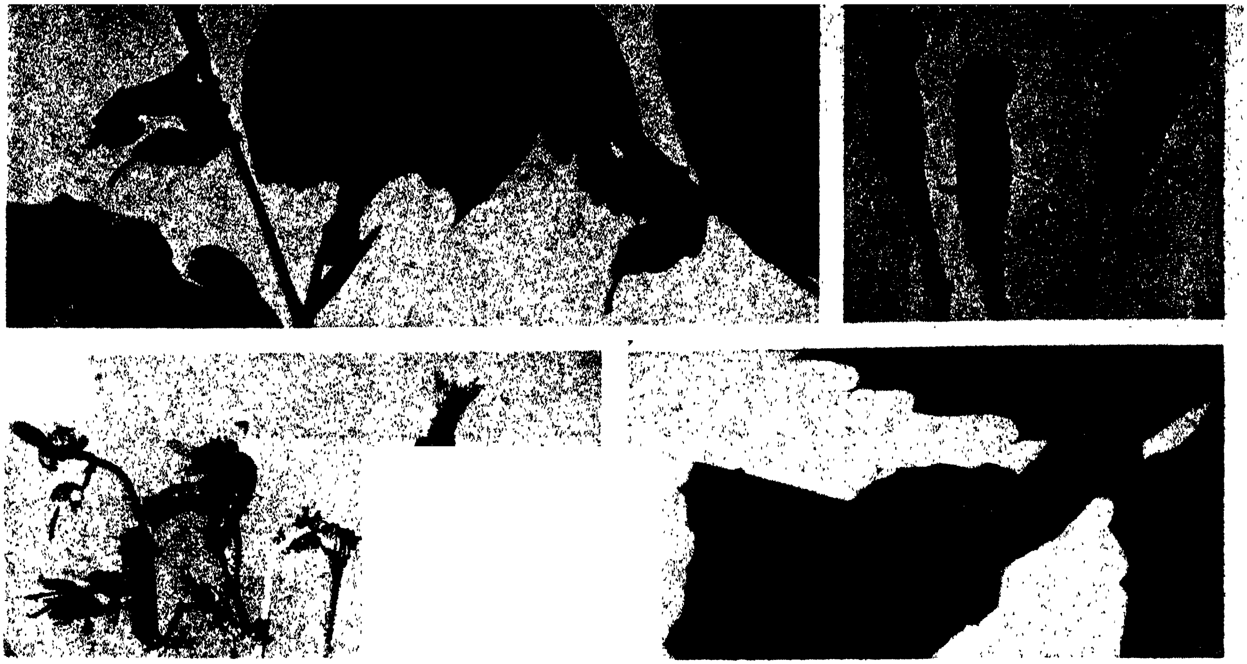
Poplar hawk moth

Purple thorn moth

Swallow-tail moth

MOTHS OF THE GLOAMING AND THE DARK HOURS OF NIGHT

Between moths and butterflies in Great Britain it is easier to draw distinctions than between those of other parts where, in some cases, the one sort copies the habits of the other. Most butterflies appear by day, have clubbed antennae and all four wings working separately, while the moths usually prefer the evening and the night, have unclubbed antennae and have fore and hind wings joined. The number of moths about will soon be realized by a slow drive down a country lane in a motor car at night. The head lights attract dozens. Photos: H. Bastin & J. J. Ward.



J. J. Ward

VORACIOUS CATERPILLARS OF CINNABAR, BUFF TIP, LOBSTER AND PUSS MOTHS

On a ragwort plant beside the way is the place to look for the black and yellow caterpillars of the beautiful cinnabar moths. They are to be found in July and August especially on hillsides. Here (bottom left) is one on a flower head of its food plant. Next (bottom right) we have some full-fed larvae of the buff tip moth, while above are two larvae of the lobster moth (top left). The resting one on the left and the feeding one on the right both look like shrivelled leaves. In the upper right hand photograph are three puss moth caterpillars.

trespass on that territory, and all intruders of their own species being warned off with the utmost rigour.

The robin is indeed a pugnacious bird, for even when all the excitement of the breeding season is past, and the pairs have parted company, each robin, whether cock or hen, still likes to have its own little bit of country, its estate which it keeps to itself and to which it does *not* invite visitors of its own kind. This is the reason that we hear the robin's song in the chill days of winter, when most birds are far too busily engaged in food hunting to think of singing. That cheery little song is a warning to its friends and neighbours, telling them that this stretch of wayside has an owner and that all other robins must keep away—when they do not take the hint the fun begins! And many a merry duel is fought during the frosty days of winter.

WRITING of winter reminds me of that frequent sight on a winter day, a song thrush searching the hedge-banks for snails, and bringing its victims to an "anvil" on the road. Thrushes are very fond of snails, and when food gets scarce, when fieldfares and redwings are stripping the crimson "haws" from the thorn bushes, and the wood-pigeon flocks wing their way overhead, the search becomes a keen one. Each thrush prys and peeps, glancing under the ivy leaves, beneath the tufts of grass, into every secret nook and cranny, to drag forth the hidden snails, yellow ones, striped ones and brown ones, and bear them to their doom. Now a snail in its strong shell is not an easy morsel for a delicate-beaked bird like a thrush, but the thrush has a simple method of extracting that dainty morsel, the snail, from its sheltering house. The bird merely carries it to an "anvil" and beats it thereon until the shell is broken into fragments, when it has nought to do but pick out the snail and eat it!

By an "anvil" I mean a convenient stone of just the right size and shape for the thrush to beat the snail upon. When a thrush finds a good stone it uses it again and again, until the ground around is littered with snail shells. I once made a series of experiments with a young and inexperienced thrush to find out if the bird would know instinctively how to deal with snails. It did not; it had an instinctive aptitude to beat unmanageable food, but it took it some time to discover that snails were edible, and then had to find out how to deal with them. It had to learn how to use an anvil.

Another common sight in the lane, or rather from the lane, on a winter day, is the flocks of winter migrants feeding in the fields, the redwings in large numbers on the meadows, and the white-rumped bramblings, together with chaffinches and other finches, on the arable ground. The fields are full of life; here you see a stately cock pheasant stalking along, and there a covey of spruce partridges. By the way, we might speak of the partridge as one of the birds of the lane, for when spring returns, and the question of nesting-places comes to the fore, it is a common thing for the hen partridge to creep into the wayside ditch, scrape a slight hollow, and lay her nine or ten olive eggs beneath the meadow-sweet.

Chapter CX

Morals and Manners in the Animal World

By Frank Finn

Author of "Birds of the Countryside"

If the old saying "manners makyth man" be correct, a good many of the lower animals are more human than a large proportion of humanity, and if the expression "living like the beasts" be taken to mean living in a turmoil of strife and sensuality, this also is misleading in many cases, though it must be admitted that the morality of beasts is as a whole far below that of birds.

The beautiful emotion of love—the exclusive preference for an individual of the opposite sex of the species—may, however, occur in beasts as well as in birds, and a very touching instance of this is recorded by Dr. Anderson, the first superintendent of the Indian Museum. The Calcutta Zoo in his time had three orang-utans, a male, a female, and a young one. As the narrator speaks of the female as the constant but distant companion of the male, they were evidently not mated; yet his love for her was such that when she died, he persistently remained on the roof of the shelter, gazing in the direction in which her body had been carried away, and unmindful of the fierce tropical sun, which a forest animal like this would in its right state of mind avoid. This naturally resulted in sunstroke, and the poor "man of the woods" came down, dizzy and staggering, to die. The youthful member of the party had also displayed much grief, if in a less dignified way; it had to be prevented by force from following the corpse, and when so treated screamed and rolled on the ground in passion, a very common trick in orang-utan children.

It must be admitted that Marcus, the late great orang at the Zoo, and the grandest animal I ever saw, did not show by any difference in behaviour, that he grieved when his female companion died; but naturally one cannot expect to find equal intensity of emotion in all individuals of a species. A very charming monkey family that lived long at the Zoo was a pair of capped langurs and their successive children. The male was separated as a precautionary measure when there was a young baby, but he tore a hole in the canvas hung over the netting in order to peep at the family, and when he was re-admitted all one could say was that the children did not pull his tail as they did their mother's.

THE MORAL OF GOOD MANNERS

Topical

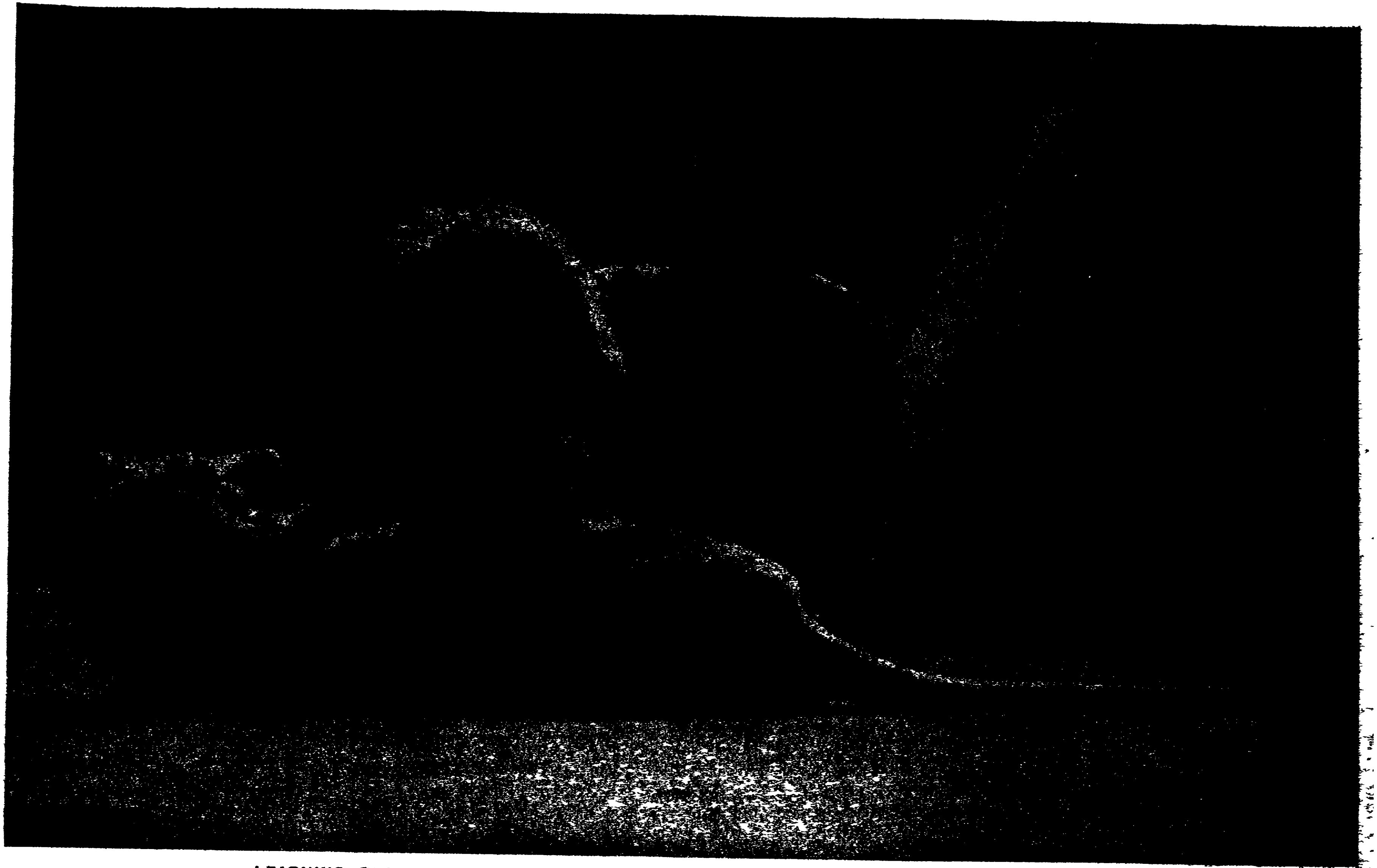
Such natural enemies as dog and cat can overcome even the old-established antipathy if the acquaintanceship is begun at a sufficiently early age. There is also a noticeable tolerance of young things on the part of adult animals, while good behaviour begets kindly treatment.

I have seen the flapper monkey cuff her junior's head for doing this, but the mother was so sweet-natured a creature that on one occasion when a very tiny infant was reaching out its minute hands for something to play with, she actually turned up her tail and held the tip of it convenient to the little creature's clutch.

Moreoever, she was not, as female monkeys so often are when in charge of young, shy, touchy and jealous, but would bring the baby up to the bars, when lady visitors would say to her, "Oh, don't drop it," not noticing that the infant did not need to be held carefully, as it was clinging quite tightly to her fur with hands and feet on its own account.

A pigtail monkey, at the Zoo in 1929, and the mother of the quaintest of little imps, was also a very reasonable animal, and let the little creature play about the cage as it liked, evidently realizing that no possible danger threatened, as the two had the cage to themselves. When, however, the big Gibraltar monkey next door started on a wordy war with the Japanese pair in the cage on the further side, it was amusing to see how she caught up the child and sprang to the bars on Gibraltar's side, evidently anxious not to miss any of the fun, but at the same time to be quite sure that she knew exactly where baby was all the time.

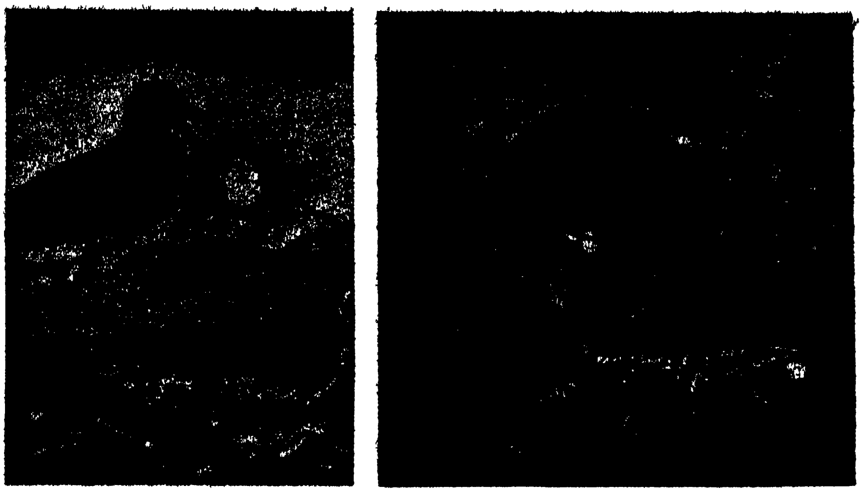
When a previous Japanese pair had a baby the mother was indeed very jealous,



LEARNING THE RULE OF GIVE AND TAKE: LIONS AT PEACEFUL PLAY IN THEIR CAGE

When two lions are shut up together in a cage the authorities have a pretty good idea beforehand if they are the sort that are likely to make friends. But nothing is certain about the behaviour of these big cats and they may take an instant and unhesitating dislike to each other. A lion's dislike is apt to be dangerous. On the other hand the pair may live in amity for years such as these companions here which are seen performing, in fun, the evolution they might well go through in deadly earnest if they were annoyed with each other. Even a lion must learn the law of give and take, especially when the lesson is backed by tooth and claw.

and her husband loyally joined in whenever her nerves exploded against her neighbours or the public, though he took good care to see he got the lion's share of all the cakes and sweets that were bestowed on the family—the most spoilt monkeys the Zoo ever had. The patience of this grim-looking beldame, however, was admirable; time and again she would clutch her straggling imp by a leg or by its little bob-tail, brush the sawdust out of its fur, and re-arrange it in her arms when it had turned upside down to grab her eyebrows with its hind hands, only to go through the whole performance again a few minutes afterwards.



ROBBERY COMMITTED BY CURLEW AND LIZARD

There always seems to be some excuse for thieving when that crime is committed under the stimulus of sheer hunger. In the case of the curlew, on the left, this cannot quite palliate the offence since curlews have many other things at hand to eat Laziness may have been the cause of this robbery. As for the lizard (right) it is an inveterate egg stealer

Some monkey mothers, however, are not so long-suffering; a late member of the Zoological Society once told me he had seen a monkey haul her baby across her knee by the tail and spank it, and Tickell very amusingly describes how wild crab-eating monkeys in Burma pull back truant youngsters by that convenient appendage and cuff their heads, though they soon make amends and appease the fractious outcries of the *enfant terrible* by cuddling it up to the breast.

I have never heard women object to the insinuation of our simian affinities when a mother and child monkey are in question—the resemblance is too touchingly obvious.

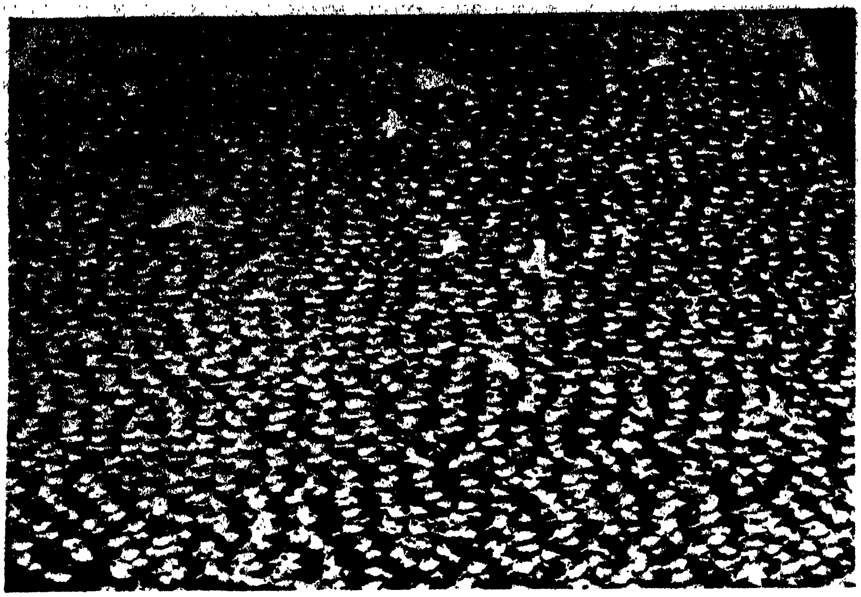
There is, however, an ugly side to monkey nature, and Hughes, a late member of the Indian Geological survey, has described how he saw regular warfare, complete with atrocities, between two troops of the common langur or entellus of India. The leader of the smaller party, a fine fellow in every way, engaged two males on the opposite side, and had actually killed one, when two females from the other side forgot their neutrality and mortally injured him by a treacherous attack from behind. The winners then held the losers imprisoned on a tree, and shook down a nursing mother, causing her death in addition to his. Here the animals were living in a state of polygamy, but a polygamous animal may exhibit finer sentiments at times. There are few more inveterate polygamists than the beautiful Indian blackbuck, which will hold and rule half a hundred does; yet a pair have been found in company only with their fawn, which the buck, with rough tenderness, butted over again and again when it tried to follow them in retreat, till it understood that it should " keep dark and lie low."

An example of very opposite behaviour was told Darwin by a Gaucho in the Falklands; he saw a wild stallion brutally maltreating a mare by biting and kicking her, till she was at last forced to leave her foal, too young or weak to follow the herd, to its fate, which would be, no doubt, to be worried by the local fox-wolves which then existed, or to have its eyes pecked out by the " Johnny Rooks " or Falkland carrion-hawks. This was a case of real equine vice, yet Darwin elsewhere quotes a French authority to the effect that stud-stallions are capable of falling in love with a particular mare; and I was once told by her owner of a case in which a mare showed touching and unexpected attachment to him. This animal had a dislike, unusual in horses, though common in donkeys and mules, to entering water; yet, having on one occasion ridden her down to the sea-shore and picketed her there while he went into the sea to bathe, he found her swimming out to him, desire to rescue him from what she regarded as danger, or at any rate to be with him, having impelled her to pull up the peg and enter the element she hated.

The lion has long had a reputation for generosity and magnanimity; it certainly has some idea of what may be called justice, for ancient and modern writers have both noted that when hunted it will single out him who inflicted the first wound for attack. Anyone also may see at the Zoo that lions do spare mice, which are not to be seen disporting themselves in the cages of the other great cats as they do very freely in the lions' dens.

The story of Androcles and the lion may be really true, for a female moose, an animal probably far less intelligent than a lion, has been known to approach a man under circumstances suggesting that it desired his help, it having been badly injured by the antler of an unchivalrous male.

The tiger has always had the reputation of being fiercer and more merciless than the lion, and it is certainly less social in the wild state and less depend-



This may be from a desire to keep an eye on the movements of a foe, or they may look to him for protection against a far worse enemy to birds, the leopard.

The leopard itself has a particularly bad name for ferocity, and is very unreliable in captivity; yet a leopard in West Africa, where the reputation of its species as an enemy to man is worst, has been known to live as a domestic pet, so tame that he was harmless even with the children of the house, who actually pulled him down by the tail on one occasion when he was in their way at the window.

H. S. Cottrell

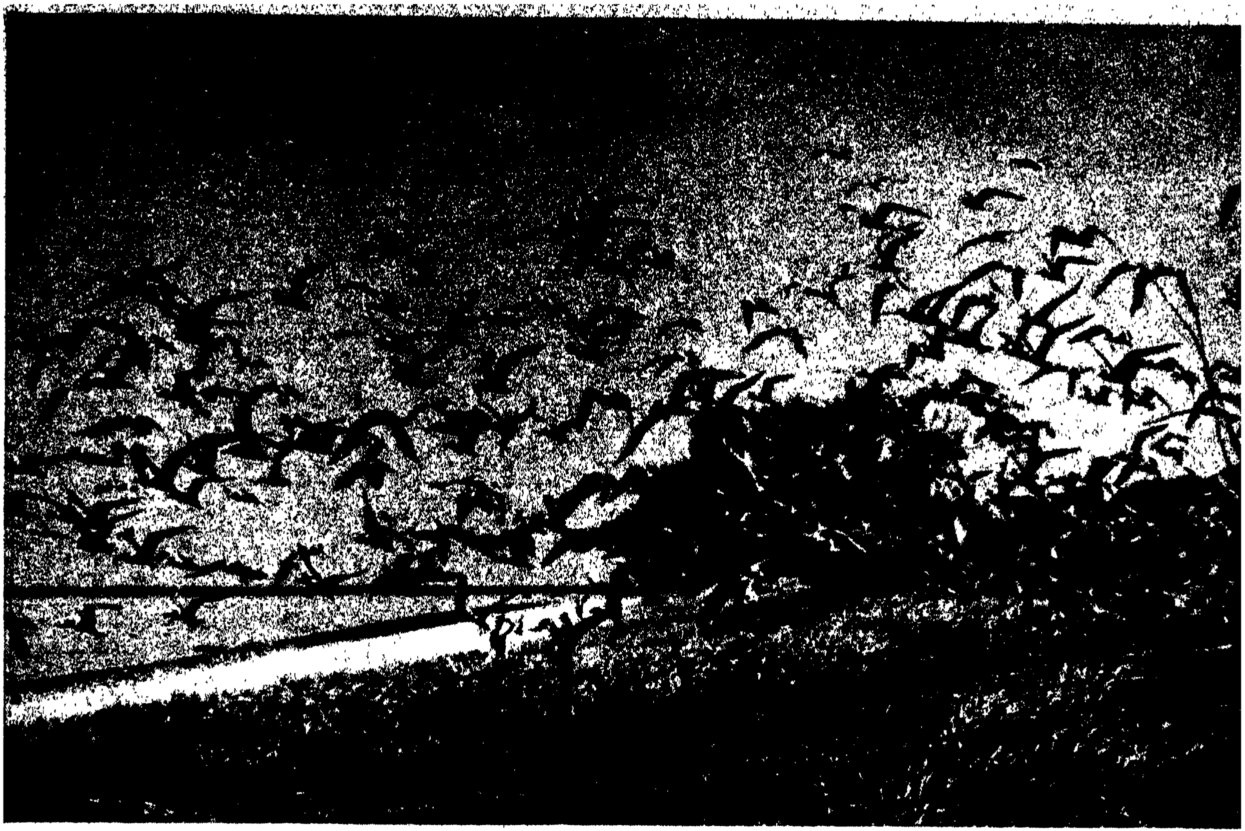
GANNETS' SUCCESSFUL COLONISATION OF A NEW ZEALAND CAPE

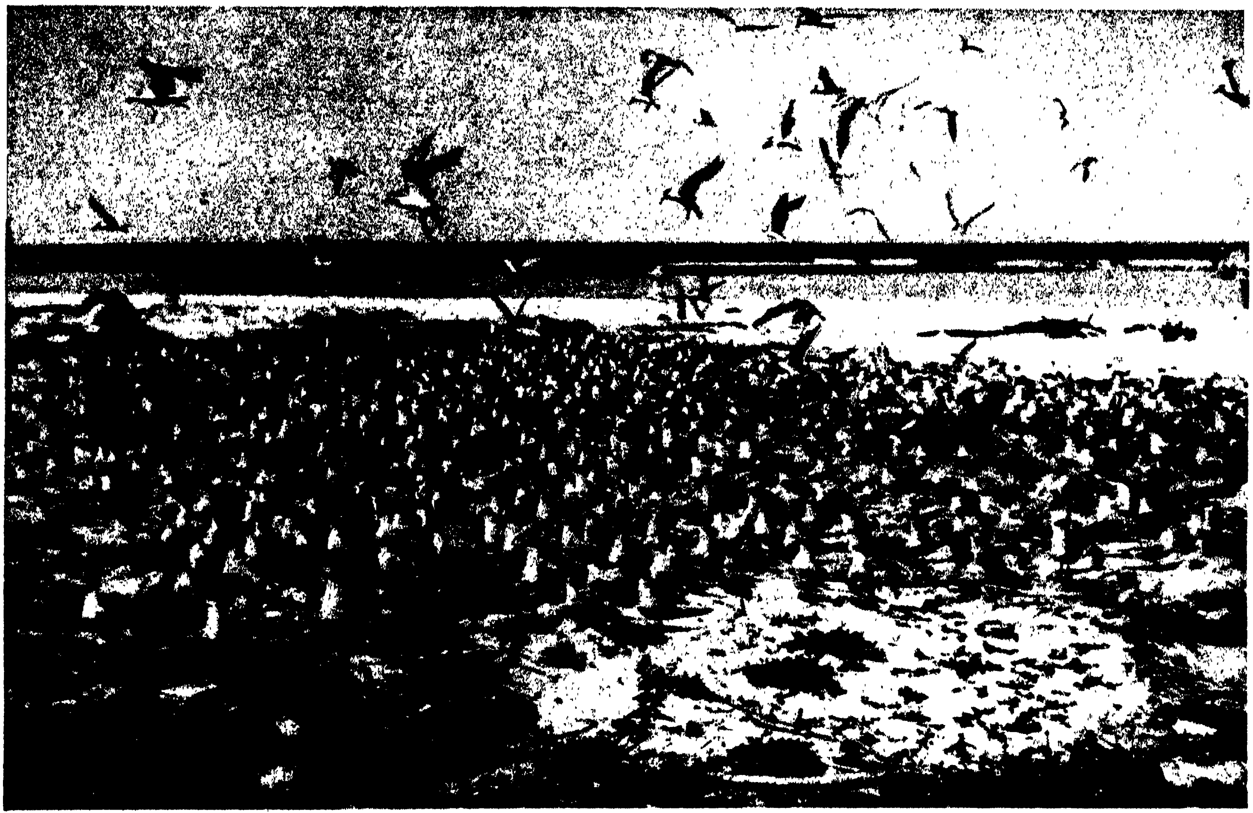
At Cape Kidnappers, which is in North Island, New Zealand, at the southern extremity of Hawke's Bay and quite near Napier, a most interesting sight is to be witnessed where thousands upon thousands of gannets, or solan geese, nest together without trespassing on each other's preserves. In the nesting season the birds are very tame.

able in captivity. Yet, as Sterndale points out in his book on the mammalia of India, natives distinguish between the characters of tigers living in their neighbourhood, saying that some are morose and others mild; and another Anglo-Indian authority mentions a tiger which lived in the same neighbourhood for twenty years, preying on his human neighbours' cattle, and during that time only killed one man, and him by a curious accident. The peasants were netting for hares, and caught the tiger, which knocked over and incidentally killed one of them in clearing the way.

A casual death-blow on man inflicted by mistake has been known to make a harmless tiger into a man-eater, as he has thus learnt his power over what seemed to him uncanny creatures; that the tiger above mentioned went no further may be due to his having come to regard his neighbours with a friendly eye, for it is a curious fact that carnivores, solitary as they often are by the necessity of keeping a hunting-ground to themselves, may form friendships with weaker animals in captivity. This is well known with the lion, and a flock of wild guinea-fowls have been seen to run off with a troop of lions; while only recently a case was recorded at the Manchester Zoo, and photographed, in which a tigress made friends with a peacock. Peafowl are killed by tigers in India, and yet are often found in their neighbourhood.

It is noticeable that the cats as a whole are far superior in manners to the dogs—less wantonly aggressive, and without the vile inclination to persecute the injured and obscenely to insult a defeated foe. Moreover, the wolf and jackal are habitual baby-stealers if they get the chance, and all the good qualities we find in the dog have been developed by the long selection of exceptional individuals which displayed an amenable disposition towards ourselves. Wolves, which when reared in

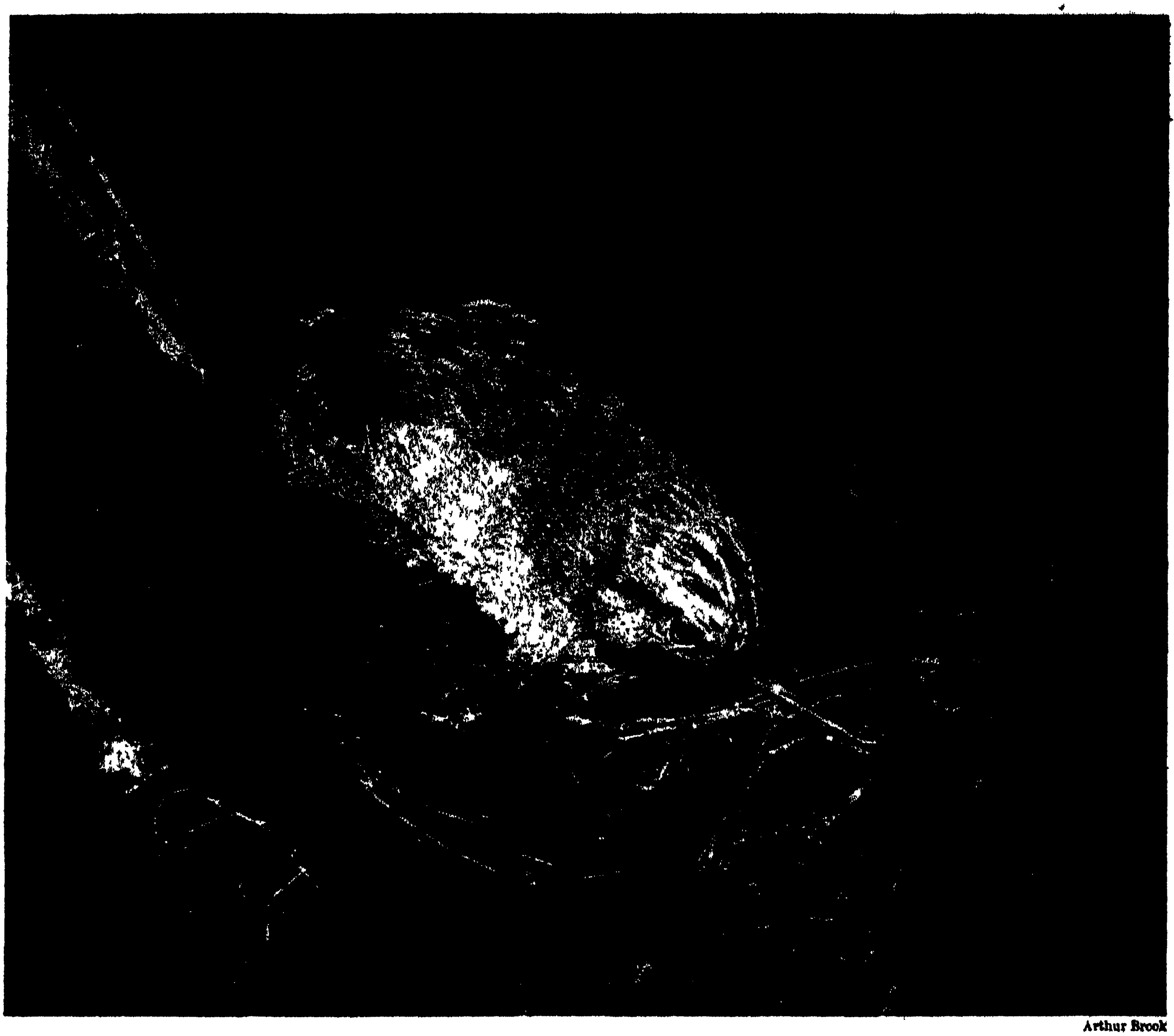




Otho Webb

BATTALIONS OF CRESTED TERNS BREEDING ON MASTHEAD ISLAND, AUSTRALIA

Crested terns breed and nest by the myriad on Masthead Island off the coast of Queensland, Australia. The lower illustration shows them as they look when undisturbed. Above thousands are flying and screaming overhead at the approach of possibly dangerous and in any case suspicious human beings. Despite the close proximity of these thousands—conditions under which human beings are often excused bad manners—these birds do their business of bringing up another generation in a spirit of mutual forbearance.

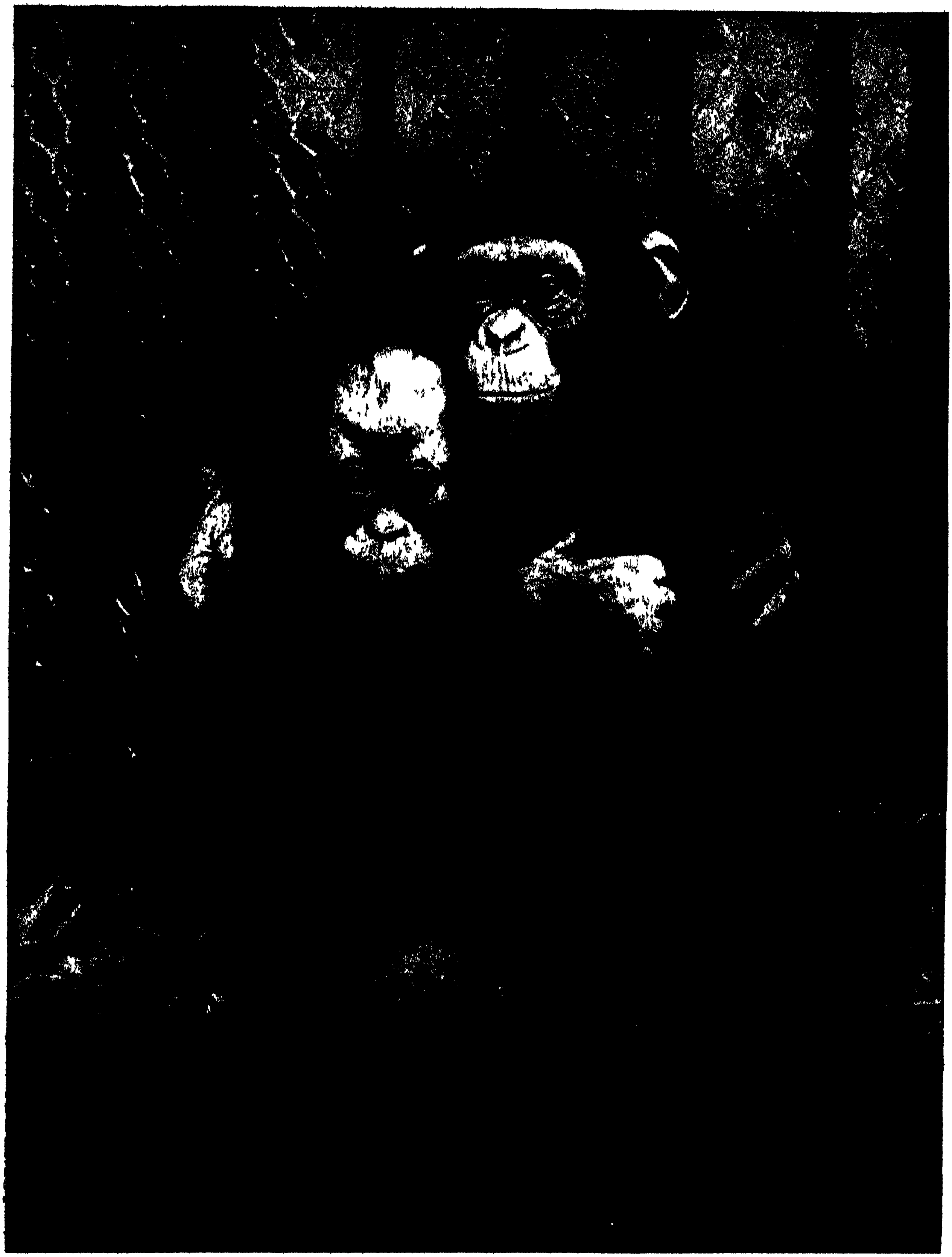


Arthur Brook

E.N.A.

WELL PRACTISED AND CUNNING EGG THIEVES: MONGOOSE AND JAY

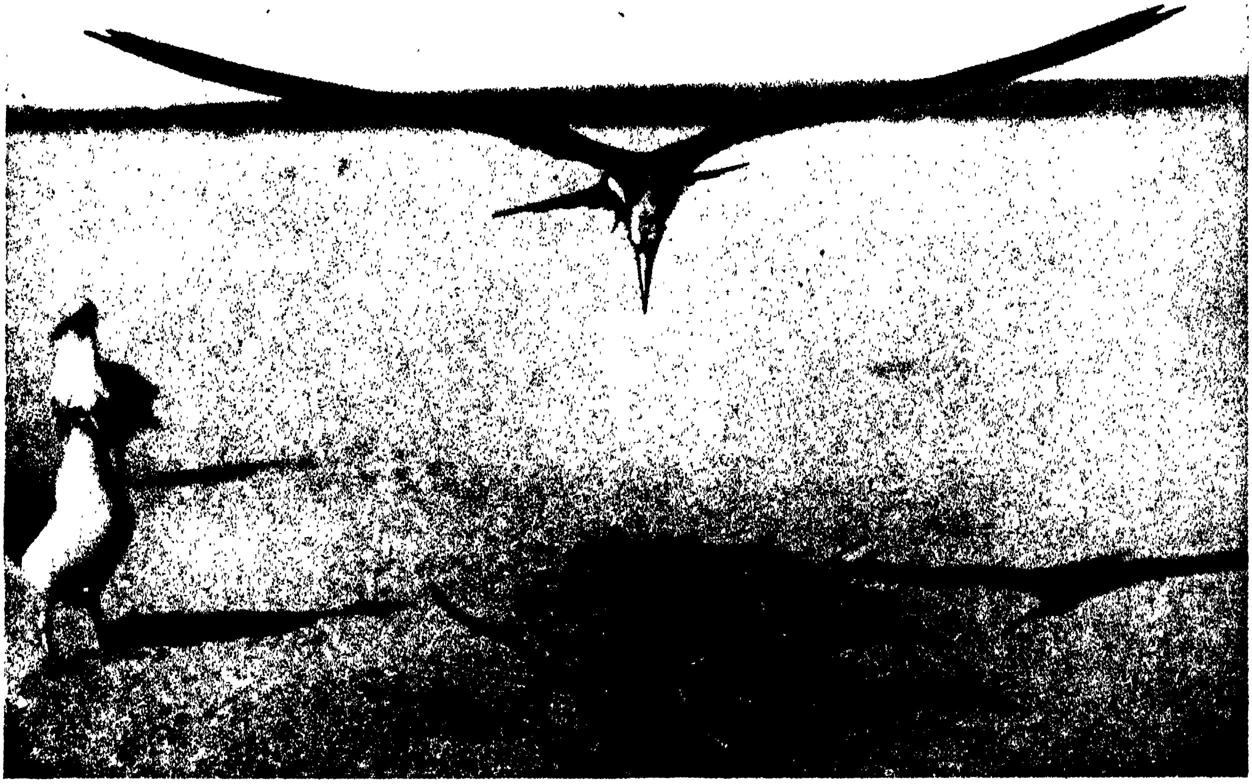
As is well known, the mongoose has a certain skill in killing snakes. It is not so widely known that it often prefers birds' eggs to snakes and has as great a facility for stealing them. Our lower photograph shows a mongoose confronted by the eggs of an ostrich and a hen. Having failed to cope with the big shell it made off with the small one. Above is a jay, a bold bird bandit with a refuge in the thickest part of the woods, stealing an egg from the nest of an absent missel thrush.



AFFECTION AMONG THE ANTHROPOID APES: CHIMPANZEE AND ORANG

If apes and men branched off from their common stem of the genealogical tree at a comparatively late date, as some scientists assert, it is not so surprising to find the culture of affection carried to greater length among the apes than among any other animals. While comparisons of men and anthropoids should not be pressed too far, yet it is undeniable that, in their expression of emotion, apes are nearer to the human than the rest of the animal kingdom. Here we have two apes of different species whose manners are mutually kind.

Otho Webb



E.N.A

DARK AND BRIGHT SIDE OF COMMUNITY LIFE AMONG BIRDS

It is always the way of things that the peaceable community is eventually preyed upon by the irresponsible and much more active pirate. This frigate bird (bottom) swooping down on the nest of a helpless booby is a case in point. The booby is as defenceless as its name suggests, and it has to put up with having both the fish which it has caught and the nest materials it has laboriously collected being stolen. The upper photograph, taken on Pisonia Island in the Gulf of Carpentaria, Australia, shows a colony of noddies nesting happily together in a tree.

E N A

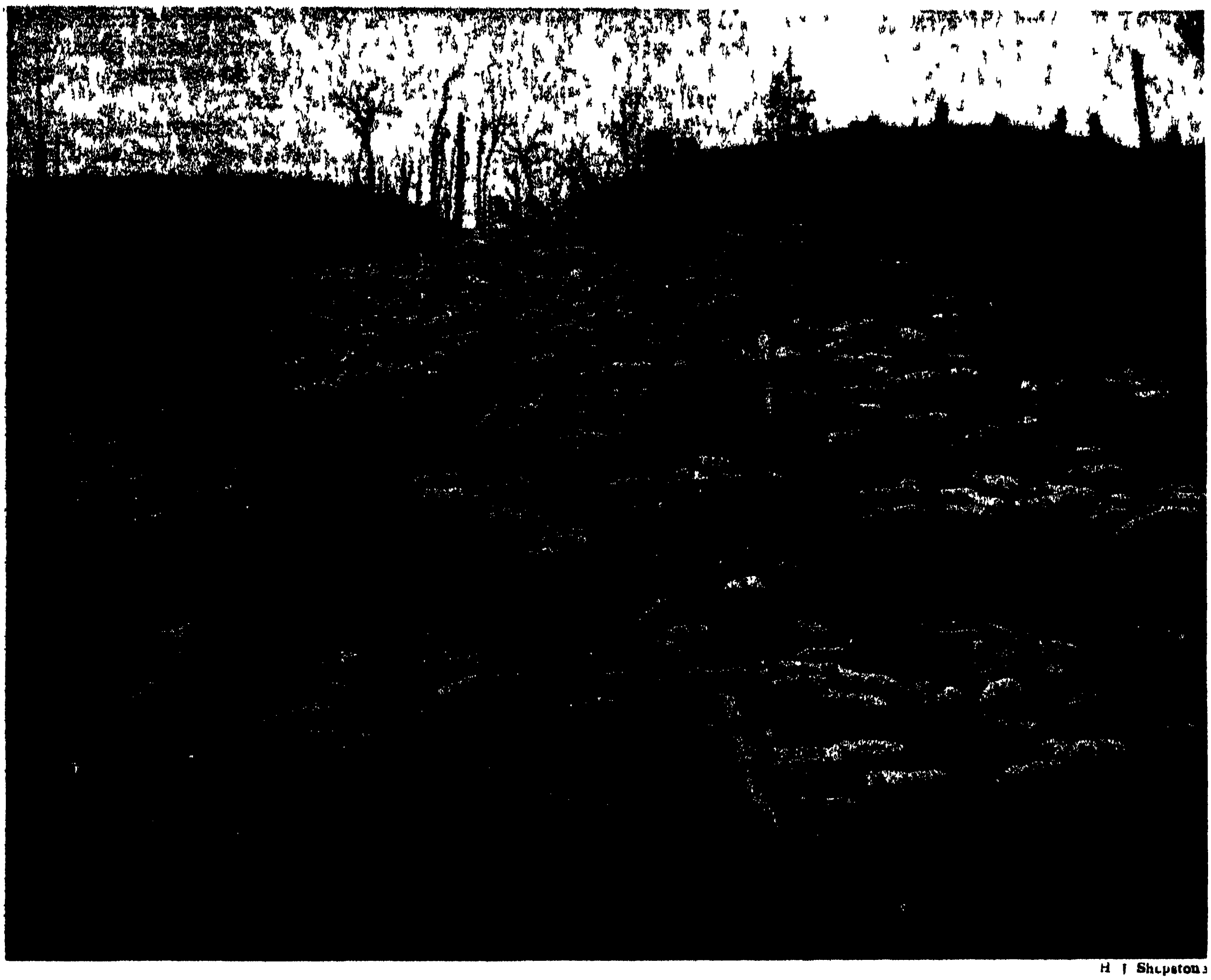
FRIENDLY BEAR FIGHT AND A BULL SEAL AND HIS FAMILY

Bears at play are sure to draw a good audience at the London Zoo (bottom) The play consists mostly of a sort of mixed fight, half boxing, half wrestling, but conducted with a nice regard for the border line which separates the serious from the frivolous It is rarely that a game develops into a quarrel In the upper photograph we see an old bull seal inhabiting one of the lonely islands off the coast of Alaska with his wives and family He will unhesitatingly risk his life in their defence.

H. J Shepstone

A HERD OF WILD REINDEER QUIETLY SHARING THE WATER THAT ALL MUST HAVE

Animals that live in flocks behave according to the necessities of the flock and even in the most vital business of life, eating and drinking, take their turn without too much scrambling at the feast. Here we have a herd of reindeer which has come down to the water on which life itself depends If all cannot drink at once the rule of first come first served is obeyed and each one gets served in due course In other parts of the world herds of different animals obey the same code about drinking as between herd and herd. There is a considerable number of animals here, over a space of several acres The majority have yet to come and drink Notice the wide spread of the antlers, reflected in the water, of the animal nearest the camera



H J Shepstone

TOLERANCE OF INDIVIDUAL BY INDIVIDUAL IN A BIG AUSTRALIAN SHEEP FLOCK

Sheep seem to be the most unintelligent of animals Domestication is the sole cause of their apparent lack of brain, for they have been bred to a standard, either for wool or for meat, and standardised individuals are the reverse of intelligent, since intelligence breeds individuality But when left to run more or less wild, as are the New South Wales sheep seen here, some intelligence is soon developed and each sheep seems to realize what is the code of manners for the flock and obeys it There is no strife about feeding

captivity displayed the fidelity of the dog, are on record, and the pariah dog of the east, which represents the next stage from the wolf and jackal, although he has been described as " a bully when he is full and a cur when he is empty," occasionally produces stock of a far better nature I knew two at one time at Mombasa, a dog which had unusual courage and had even fought a hyena, and a bitch which, though not demonstrative, showed marked fidelity Had these been paired, no doubt their offspring would have been as good as or better than themselves, and early dog-breeders would have seen to this when dogs were first tamed

THAT there is a good deal of the wolf left in the dog is shown by the frequent cases of sheep-worrying that occur, though we can only regard this as a crime from a human point of view, for after all such beasts as sheep are the natural prey of the wolf, and raw mutton must taste to a dog much better than dog-biscuit, to say nothing of the pleasure of the sport.

The grizzly bear is an animal which used to have a great reputation for ferocity , according to the old tales, if " Old Ephraim " got a man's wind he dropped all other engagements to settle with him Improved fire-arms did away with this inconvenient disposition, and grizzly bears, like other large animals which used to be more dangerous than they are now, have been reformed at the rifle's mouth.

But Richardson tells a tale of a grizzly of the good old stock which displayed something very like magnanimity, according to Reskarrah, an aged Redskin chief in the fur countries, who told how, confronted along with his old squaw by a big grizzly on the other side of a stream, he had induced the bear to go away and leave them in peace by assuring him of the respect he felt for the ursine family, none of whom, he told Ephraim, he had killed except under sheer necessity

Animals, like young children, instinctively respect sincerity in many cases, and there can be no doubt that, for the time being at any rate, Reskarrah's respect for the bear was sincere enough of its kind. A shouting attempt to scare the brute off would very likely have led to trouble.

Of all beasts, except the dog, which is so artificial an animal psychologically that it must always be considered apart, the elephant has most engaged the kindly feelings of man—that is of civilized man, for the savage is not so enthusiastic about him, not being in an equally good position to teach him respect for human life and property. Making all allowances for ill-natured elephants, however, the beast is certainly remarkably harmless for its size, and compares very favourably with the hippopotamus and with at least the black African rhinoceros and with the Indian wild water-buffalo, all of which bear decidedly bad characters

"ROGUES" or destructive and murderous Indian elephants seem always to be males, but that the gentler sex has its failings also is evidenced by the fact that unpleasant cow-elephants, not being able to bite off their rivals' noses to spite their faces, at any rate contrive to ruin the view of the rear elevation by biting off their tails. The African elephant is more peppery, though, in defence of the animal, it must be taken into consideration that a large proportion of the species have been themselves peppered with various scratch missiles by native hunters However, when the film "Paul Rainey's African Hunt" was shown in London before the writer, a she-elephant which had come down with her baby and flapper daughter slapped the former with her trunk because it bothered her for milk while she was scraping for water in the river-bed, and when the sister came towards her apparently saying, "Oh, ma! don't be so rough with baby," fairly chased her off the screen.

While, also, one cannot blame Napier, an elephant which had been shipped to the Andamans for timber-work, for going on a one-elephant strike which lasted for fourteen years of roguery, it must be regarded as a blot on his character that an official record accuses him of visiting the tame-elephant lines at night and not only injuring a male elephant, but killing a female outright, picketing the picketed should have been peacefully performed, with due consideration for the gentler sex.

THERE is not much room left to discuss this subject in relation to birds, but anyone who can observe a poultry-yard can see how just is the estimate of the ancients of the cock as the knight among birds, and of M. Rogeron's characterisation of the duck as the jolly bourgeois; while he will find in the guinea-fowl an arrant hooligan, and in the gander and turkey-cock generally coarse bullies—though quite recently Sir W. Beach Thomas recorded a case in which bubbly-jock fought a rearguard action in defence of his family against a fox until they got too near the farmstead for Reynard's liking.

The eagle, credited, like the lion, with magnanimity, is more inclined to pacifism than are some of the less noble members of their respective families, and very possibly the small birds which make their homes in the interstices of his nest do so largely to avoid "the lesser tyrants of the air."

A chained eagle has been known to retire, as if conscience-stricken, from the body of a chained falcon it had killed, and this brings us to the important question as to whether animals know when they have done wrong—whether, in fact, they have a moral sense. In the case above given the eagle may previously have been corrected or threatened for aggressive behaviour to its neighbour, and obviously the signs of what look like conscience in dogs generally have relation to the man-made laws by which canine behaviour is regulated, and do not reflect actual canine opinion. Yet Romanes tells of a very sensitive terrier of his which not only interfered when other dogs were beaten, but even seized his master's sleeve when he touched the horse he was driving with the whip; this dog was evidently a born humanitarian There is also a recent record of an Alsatian bitch which of her own accord would go the round of the farm and not only see that all the animals were in their proper place, but incidentally stop any cock-fights

Cocks themselves, as is well known, will stop cockerels from fighting, and a wild boar has been seen to knock apart two porkers who were engaged in a duel This may be an unconscious instinct to check what might develop into a menace to the overlord, but such an explanation will not apply to this police instinct when applied to alien creatures, as in the case of the dog just mentioned and in the numerous cases whereon a stronger bird will stop the disputes of weaker alien species

IN London, too, I have seen two cases, in birds of the same species, of reform under improved conditions of life, and of original and inexcusable sin defeated by heroism in the oppressed. An unmated male black-necked swan at the Zoo, confined for long in a small pen for bullying ducks, was at last put on a large pond with a mate. There he was the kindest of creatures, carrying the cygnets that were born to the pair more often than their mother did.

Yet a mated swan of the same kind, not even pinioned, but living with his mate, also full-winged, on the fine lake at Kew, not only never carried the cygnets as far as I saw, but bullied a family of Chinese geese until the gander, in spite of the fear he had previously shown of him, attacked him in desperation when a gosling was seriously threatened, with the result that the swan soon gave way.

It may be mentioned finally, however, that wanton mischievousness seems as a rule to be developed in mammals and birds in proportion to the vegetable element in their diet, the vegetarian species being the most quarrelsome and mischievous, and then the omnivorous; the ferocity of the carnivores is directed to the utilitarian purpose of killing prey, and the unsociability they often show is simply the need of the game preserver.

Chapter CXI

In the Grip of the Past

By Professor J. Arthur Thomson

Regius Professor of Natural History, Aberdeen University ; Author of "The Study of Animal Life"

Charles Darwin was interested in the way a dog turns round and round on the hearth-rug, as if to smooth down the herbage and make a comfortable bed for the night. This is a habit among wolves, from which the domesticated dogs were derived, and the habit has lasted for many thousands of years since Neolithic Man first succeeded in making the dog his partner. No doubt the habit of turning round and round would be useful in ancient days before there were houses in the modern sense, but it has long ceased to be necessary, and yet it persists. It illustrates the hand of the past on the present Perhaps there is some significance in the fact that the past asserts itself in this case of the sleepy dog, when the unconscious has more chance to exert its influence than in waking hours.

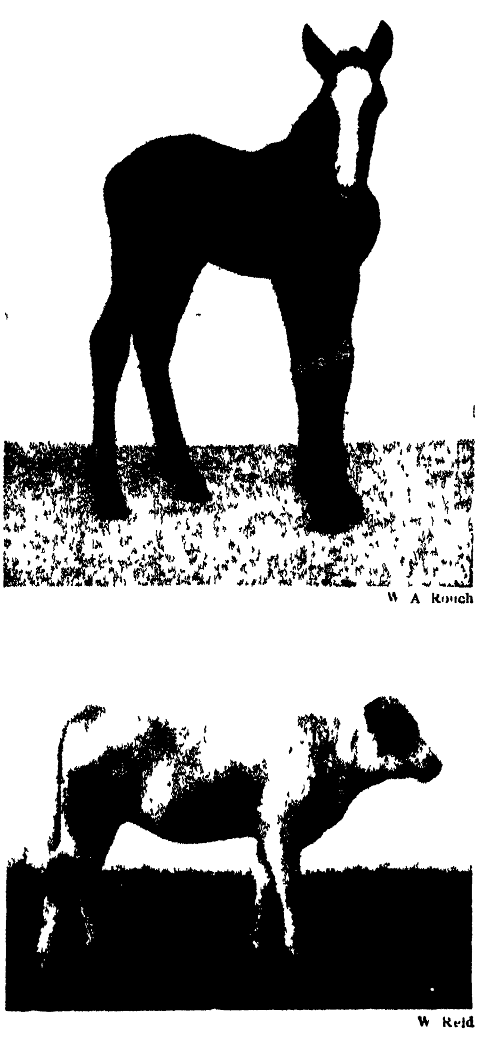
The same survival of old habits is seen when the well-fed dog buries a bone or some remains of its meal, for this is a wild trait, seen, for instance, in the fox. Another thing we have all seen a dog do is scratching backwards with its hind feet, as if to throw earth over its excrement. It no longer succeeds in doing this; and there is obviously no sense in scratching, as it often does, on a bare pavement The past lives on, and a habit may outlive its use.

Darwin gave a number of instances of habit-survival in his book on "The Variation of Animals and Plants under Domestication"; and there is an interesting book by Dr. Louis Robinson on "Wild Traits in Tame Animals." Let us bring together some striking examples.

Some cattle were transported from Aberdeenshire to a Californian ranch where they found themselves in relatively wild conditions. It was observed that when a cow calved away from the farm, which is not favoured in Britain, she hid her calf in a thicket when she went out to graze. This hiding of the calf is a wild habit, which has remained dormant for many generations of men and cattle, but has reasserted itself when there has been a change of surroundings in the direction of the ancient wildness.

Here it may be recalled that cattle, disturbed when at rest, rise on their hind legs first, while horses rise on their front legs first, part of the explanation being that the wild horses rest in the open plain and rise in front to see over the tall grass; while the wild cattle under the shelter of the forest or thicket rise on their hindquarters so as to keep their heads low to see under the branches of trees. More convincing, we think, is the persistence of the mare's habit of giving her foal many short drinks, while the cow gives her calf a very long drink at a time. There is a physiological reason for this, as also for the way an animal rises, but both have also to do with old habits and surroundings, for the difference becomes more intelligible when we recall the fact that the troop of wild horses shifts often from place to place, and that the foal has to stagger after its mother soon after birth, so that a big meal would be inappropriate. But it is different with the calf hidden away in the thicket, to which its mother returns to chew the cud. For our present purpose the interesting fact is the persistence of the difference in habit after it lost no small part of its significance in conditions of domestication.

Why does a horse shy ? At a sudden rustle in the hedgerow, or before a wind-borne ball of paper, it suddenly swerves and may unseat the careless rider or upset the gig. There can be little doubt as to the meaning of this nervous trick. It is almost certainly a re-awakening of an ancient "reflex" —that is to say, an involuntary automatic jerk, which saved the wild horse from being bitten by a snake or by some lurking carnivore. The profitable reaction in ancient days was to make a



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GROWTH GOVERNED BY THE PAST

While a calf has short legs at birth we notice that the foal's legs are long. In the old wild state, the ancestors of our domestic cattle hid their young, but the wild horses kept their foals trotting with them.

TWO WAYS OF GETTING UP

A horse rises on its forelegs first (bottom) and a cow on its hind legs (top) when disturbed. This is because the wild horse had to see over the long grass to make sure of safety, while the forest-dwelling cattle had to spy under the branches of the trees

sudden swerve away from the rustle or movement. Sometimes, no doubt, the individual horse is very highly strung, and sometimes there has been an individually experienced scare, but for most cases the historical interpretation is sound. The hand of the past on the present is not dead but living.

We must not think of these re-awakenings as like our own recollections, where genuine memory is concerned. For true memory is the mental revival of a previous individual experience, such as an image, or an impression, or an idea of some sort. But the shying horse on the road and the sleepy dog on the hearth-rug illustrate an enregistration of their ancestors' experience, not a memory of their own. No clear-cut dividing line can be drawn in such cases between the bodily and the mental, but the grip of the past that we are illustrating has more to do with inborn nerve-and-muscle linkages than with the revival of mental images. Let us take more examples.

The donkey is the domesticated descendant of the wild ass of North Africa, and its unwillingness to cross the smallest stream of water is probably a persistent outcrop of prejudices and preferences established long ago in the dry desert. Perhaps its fondness for rolling in the dust has a similar historical origin; but there is no need to overwork the idea. Darwin wrote: "The same strong dislike to cross a stream is common to the camel, which has been domesticated from a very ancient period. Young pigs, though so tame, sometimes squat when frightened, and thus try to conceal themselves even on an open and bare place."

DOMESTICATED sheep are the descendants of several species of wild sheep, such as the mouflons of Cyprus, Corsica, and the East; but except when they are lambs they seldom show much of the adventurousness and intelligence of their ancestors. Man is largely to blame for this, as some exceptional breeds show, for he has usually bred for wool and for mutton, not for brains. When any of his sheep persisted in being enterprising and original, he removed them from his flock by the simple process of eating them, and thus he has succeeded in evolving an ultra-docile and very stupid race. Furthermore, as the playful lambs prove, there is a depressing and stupefying influence in an over-sheltered life. Domesticated sheep are protected from all enemies; even the wolf has become a protecting dog! There is no danger except from snow-storms, and where there is no danger there is apt to be degeneration.

Among domesticated sheep we see some interesting instances of the grip of the past. Everyone familiar with a varied countryside must have noticed how fond sheep are of chewing the cud under the shelter of a low rock or against a bank broken by rabbit burrows or the like. In short, they seek out a position where they cannot be easily disturbed from behind. We may be sure that they do not think this out, for they have no enemies nowadays to be afraid of in a country like England. Moreover, they often choose a place where there is no real protection from a rear-attack, only a suggestion of a protection. The interpretation is historical, and takes our thoughts back to the fear that the wild ancestors had of carnivores. For herbivores of relatively small size the profitable habit is to graze rapidly in the pasture, and then return to the shelter of the rocks where they cannot be surprised from behind, and where they can chew the cud in peace. This is why sheep persist in huddling against the steep bank of the bunker on the golf course.

When wild sheep are passing quickly in single file along the side of a mountain, the routine rule is that they must all do what the leader does. If he or she jumps over a narrow but deep fissure or the like, all the others must do the same without hesitation. This saves time and trouble, but it is a quaint survival when it is illustrated by sheep going along the street of a town. It is often possible to see the succession of little jumps travelling along a file of sheep. Another interesting re-awakening is seen when a ewe is going to give birth to a lamb, especially if it is for the first time. There is an instinctive prompting to get away from the flock, and the ewe will sometimes force herself through a difficult hedge to separate herself from her neighbours. This is characteristic of the wild sheep. Another piece of behaviour that we see at lambing time on a sheep-farm is that the ewe scrapes with her fore-feet as if to make a little bed or cradle for the lamb that is to be born. This was useful for her ancestors who lived in rough places, but it is not needed in the modern sheep-farm.

The two words "instinctive prompting" give us the clue to the whole matter. Think again of the "gimmer," that is to say, a ewe that is about to lamb for the first time. She does not know what is going to happen, but she obeys an inborn, hereditary prompting to a certain routine of behaviour. It is quite easy to prove that she does not understand what she is doing, for she is often very much startled at the appearance of the lamb and will even run away afraid. But if she once licks the lamb, there is an instantaneous release of a series of maternal instincts, and she allows it to suckle. But she does what she does not because she understands the situation, nor because of a recollection, but because part of her inheritance is a series of instinctive promptings. There are pre-established linkages between certain nerve-cells and certain muscle-cells, and once the trigger is pulled the behaviour follows.

No one is wise enough to say how soon the creature becomes aware of what it does, and how soon there are ripples of emotion as well as nerve-thrills and muscle-contractions. But we must try to understand that instinctive promptings are inborn or hereditary, ready-made inspirations, which do not require any learning or apprenticeship. They are as much part of the racial inheritance as the convolutions of the brain or the shape of the teeth, the strength of the heart or the crinkliness of the hair.

Darwin tells us of the musk-duck (*Dendrocygna viduata*), that in its native country and wild state it often perches and roosts on trees, a very unusual thing for a duck to do. Now it is very interesting that domesticated musk-ducks, though very sluggish birds, are fond of perching on the tops of barns and walls. If allowed to spend the night in the hen-house the female will generally go to roost up beside the hens, though this may mean leaving the drake who is too heavy to mount so high.

There is a significant old story of a race that was arranged between a flock of domesticated geese and a flock of domesticated turkeys, which were to be driven for miles along the highway. The farmer who arranged the race put his money on the geese, and knowing the habits of the two kinds of birds timed the contest so that the turkeys would be passing under an avenue of trees about nightfall. The turkeys were driven off at a great pace, and the geese lagged behind. But it was a foregone conclusion in favour of the geese. For when the turkeys reached the part of the road where there were trees they flew up and roosted among the branches whence they could not be driven. The European turkey is in great part at least derived from the American wild turkey (*Meleagris gallopavo*) which roosts in high trees. The wily farmer knew that the old instinctive prompting was sure to assert itself.

Why does a hen make such a fuss when she lays an egg? It sounds like a proud hysterical excitement, but it is obviously open to the criticism that if the laying is in the open the cackling advertises to possible enemies the whereabouts of the egg. The plausible interpretation is historical. The domestic fowl is derived from the wild jungle fowl (*Gallus bankiva*) of India, a gregarious bird of the forests. The

F N A

THE GNU OF THE AFRICAN PLAINS GETS UP LIKE A HORSE

That strange animal the gnu, which seems half related to horses and half to cattle, proves its affinity with the former by getting up on its forelegs first. The gnu lives for the most part in quite open country where the cover consists of grass. In order to see over it the animal rises on its fore legs and peers about. There are also physiological reasons for the preference.

flock moves about after food and the cackling is probably useful in making it easier for the hen, that has been separated off during the egg-laying, to rejoin her companions till next time. Her call is answered and she hears where they are.

Beautiful instances of habit-survival are seen in the play of young domesticated mammals, for example kittens, puppies, lambs, kids, and calves. It has been shown by Groos and others that the play-period among animals is of value as an irresponsible apprenticeship to the serious business of life, and as an opportunity for testing variations in habit before consequences are too critical. Thus we understand why wild kittens and others should play at hunting and sham-fights, while wild sheep and goats play at "Follow My Leader" and sham-races. Play is in some measure the young form of work. But for many domesticated cats that have given up hunting, and for most domesticated sheep that have given up adventure, the playing activity has lost a great part of its meaning. Yet it illustrates how the living influence of the past may exert itself in youth, though weakening gradually as the animal reaches the age of discretion.

A FREQUENT cause of obscurity is the double use of the word habit. When intelligently controlled behaviour, such as playing an instrument or riding a bicycle, is repeated many times, it becomes easier and easier, it requires less and less attention and control, it illustrates habituation. The transmission of nervous impulses along certain lines becomes very easy, so easy that the whole succession of steps may follow almost automatically when the first one is taken. This is habit-forming in the strict sense; it is an individual acquisition—an automatisation of behaviour that required, to begin with, much attention and possibly much intelligent control. It is unfortunate that the same word "habit" is often used for acquired longings and cravings and desires which we call "bad habits"; and it is not less unfortunate that the same word is used for the customs and ways of animals, as when we say that Fabre devoted his life to studying the "habits" of insects. These customary ongoings, as they might be called, are sometimes very varied and plastic, controlled by intelligence at every turn, as is true of many of the ways of otters, foxes, and monkeys. Or they may be predominantly instinctive, as in the ways of ants, bees, and wasps. Or it may be that an animal's behaviour includes a good deal that is more or less intelligently learned, along with a good deal that is instinctive.

Whenever a customary activity has become so thoroughly engrained in the animal's constitution that its performance requires no apprenticeship or learning, then the animal may be more free to make experiments; and many birds and mammals show a happy mixture of instinctive behaviour (in the wide sense of inborn or enregistered) and of intelligent behaviour in the sense of profiting by experience and showing something in the way of judgment. This is an intricate subject which we must not pursue further, but the important point is that wild traits in tame animals are always of the enregistered or instinctive type, never of the intelligent type. This is why they sometimes last on in domestication after their original utility is past; they are part and parcel of the hereditary constitution.

IT is not that new habits acquired under the conditions of domestication oust old habits which were established in the wild life of ancestors, for this is using the word 'habit' in two different senses. The grip of the past on the behaviour of domesticated animals is illustrated in reference to little ways which were enregistered in the nervous system and formed part of the racial inheritance. The little ways, like the dog's turning round and round before it falls asleep, cannot suddenly disappear, though they may dwindle in the course of many generations.

In man's clothes there are not a few dwindling relics of structures that once were of use. At the wrist of a man's jacket there are buttons which are never used. They cannot be taken out of their buttonholes, and in many cases the holes have vanished. At the small of the back of the morning coat there are two buttons to which the tails of the coat used to be attached when the wearer was riding on muddy roads. The buttons are useless vestiges, and in our body there are much more striking illustrations of the same sort of thing.

In the inner upper corner of our eye there is a vestige of the third eyelid, which is well-developed in most mammals, where it is used to clean the front of the eyeball. In the trumpet or pinna of our ear there are small muscles, vestiges of those which move the ear in many mammals, such as the donkey. In occasional men these dwindled or vestigial muscles are still strong enough to enable the individual to flap his ear. Now these useless relics, which Darwin compared to the unsounded letters in words like leopard and doubt, are historically very interesting; they are vestiges of the dim and distant past, when they were well-developed and of use.

Similarly the persistent "little ways" that we have been illustrating are vestigial habits, which have no doubt their physical seat in some part of the central nervous system. They cannot disappear quickly for they are part and parcel of the constitution, enregistered and engrained long ago in such a way that they took a lasting grip. It is useful to remember that the whalebone whale has actually two sets of teeth which are entirely useless, since they never cut the gum. We suppose a million years must have passed since these teeth were used!

THE question rises why there are not more numerous instances of ancestral habits living on in domesticated animals. It is likely that there are more than we have as yet thought of; but there are deep reasons why the useless should dwindle. Most organs of the body are variable from generation to generation. But even if they vanish, the hand of the past lives on, holding firmly to that which is good.

Chapter CXII

Hunting Wild Animals with a Camera

By Angus Buchanan

Author of "Wild Life in Canada"

The sweetness in our holiday pleasures, or treasured recreations, often gets its origin from childhood, and can be traced back to a source where the influence of parents or environment first prompted some strong inclination that is never afterwards entirely eradicated. But whether the bent of an early love gains or diminishes as the years advance rests largely with the character or the circumstances that develop afterwards.

Some of us are fortunate; others find their favourite pursuit too much for them to hold on to against the battering of life's serious worries, and they reluctantly let go. Wherefore we, who find pleasure in photography, ought to try to put all the beauty we can into the pictures we make, since the image may be for eyes other than our own that are eager and penetrating, and full of zeal to find a responsive and happy value in the things they love.

Nearly as serious as that should be all hobbies, for with the growing of hobbies goes the moulding of character, and with the growing of character goes the making of nations.

Many of us have a deep-rooted love for Nature, and, in all sorts of ways we try when we can to lay hold of the beauties we find in it in its rarest moods.

In this connexion the camera is a boon, an ingenious invention of man, constantly made use of to-day for the purpose of grasping and recording what the eye sees in flashes of inspired activity.

The popularity of the camera has grown by leaps and bounds, and the influence of photography, with the perfection of the kinema, is an influence to be reckoned with today. It is a new mode of making record—perhaps, I might even say, a new mode of education. And it is making revolutionary changes throughout the world, in Press work and entertainment and in our school curricula. It is no longer essential to read or write to learn what is going on, neither is it necessary to shoot a rare specimen to see its form or its colours. Photography, with care and patience, can show us very much of those things to-day.

The hunting of wild life with a camera is on the increase, and I venture to think that it is helping us to understand much more about Natural History than hitherto. We cannot photograph wild creatures before we become intimate with them and their habits, and intimacy leads to understanding.

L N A

CANADIAN SQUIRREL

Telephotography makes possible the "snapping" of the shyest animals. This Canadian squirrel is sitting on the stump of a tree felled by a beaver.

I began my studies of wild life as an invalid child. Right back as far as my memory goes I can just recall that a pair of willow warblers, reared from the nest as pets, and a pair of ordinary house sparrows, played an important part in my little life of that time and were my real first treasures. Later they were succeeded by sparrow-hawks, owls, and the like.

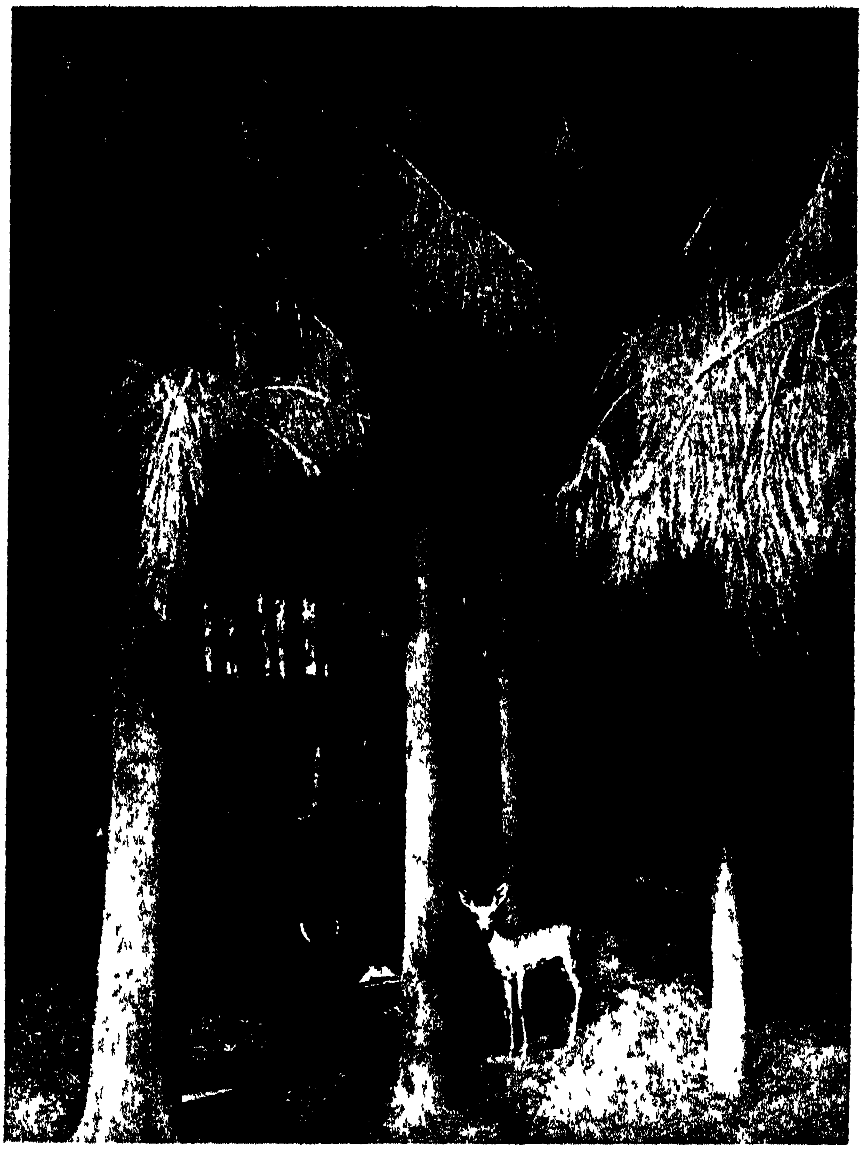
It is strange to look back. The thoughts I pen have probed the past back to the surface. I remember I photographed those pets—I see a significance hitherto unguessed. So I search for an old book and find it, and the warblers and the sparrows are before me now looking from an old album that has come to me from parents who are gone.

It is a brave step from then to the time when I was first able to photograph wild life abroad with the purpose of bringing home some pictorial record of the strange lands I visited and the creatures that inhabited them.

My first expedition was to the Arctic regions of Canada, north to the "Circle" and west of Hudson Bay. I was equipped with two hand cameras, for the kinema had yet to come in outdoor fields. Of all the Canadian birds and animals I photographed I feel I cannot do better than quote my diary description of hunting some of the Barren Ground caribou with a camera.

It was the depth of winter in the Great White North. We (two Indians and myself) were in good caribou country, and at the narrows on Sand Lake we planned to spend some time and prepare unobtrusively to influence the direction of caribou travel, so that they might come to pass right before the camera.

Our procedure was this—to cut from the forest on the shores armfuls of spruce boughs and lay them, at widely spaced intervals, on the white lake surface of the upper lake to form a thin boundary line. This fence was laid after the tracks on the forested shores had been examined and the wind considered, and Philip and Eaglefoot (the two Indians) had decided that caribou would possibly come from the west on the morrow. Where caribou were expected to come on to the lake from the forest a few boughs were placed very close to shore, so that when our quarry stepped on to the lake the strange objects would not be observed until the animals looked back or tried to return by the path they had come.



NIGHT PHOTOGRAPH OF ANTELOPE IN AN AFRICAN FOREST

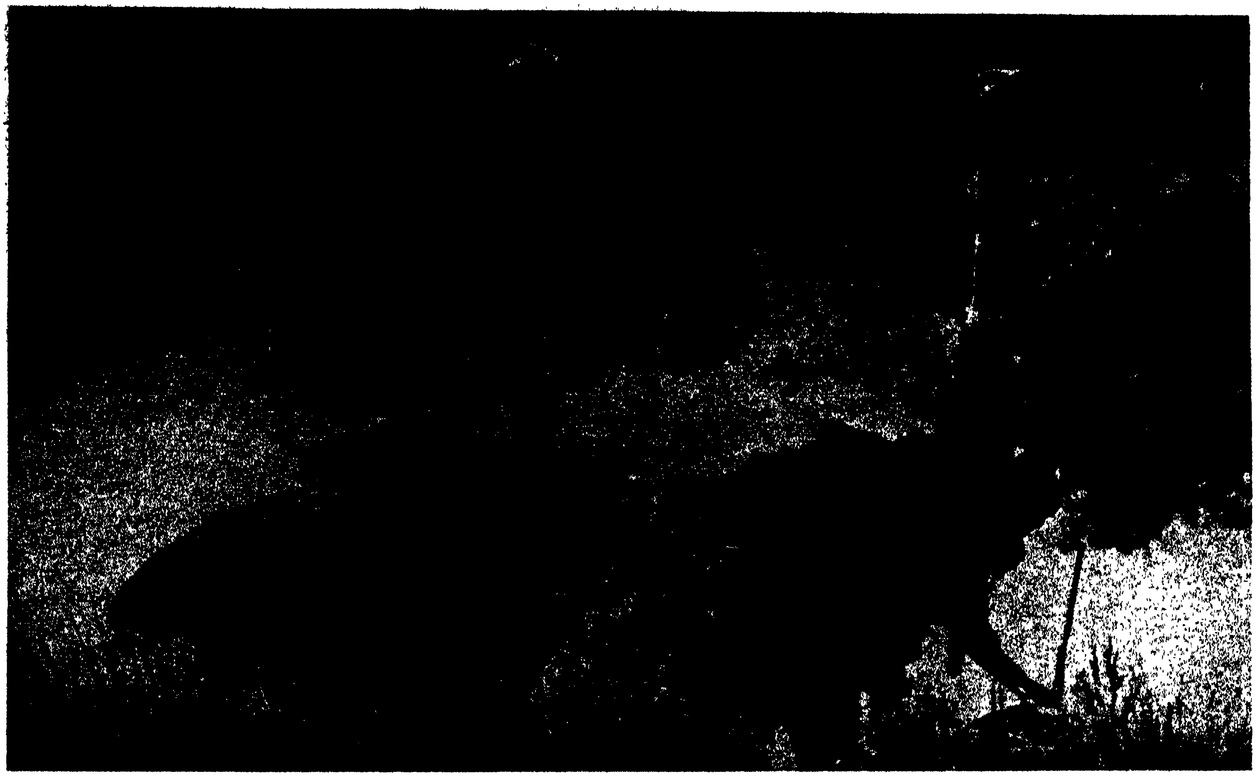
Night is the best time to photograph most animals, for then they leave their retreats and the same darkness that shields them also covers the photographer. Taking photographs under such conditions is rather like setting a trap One makes all arrangements and hopes the animal will pass by Then the flash-light powder goes off and the likeness is on the plate

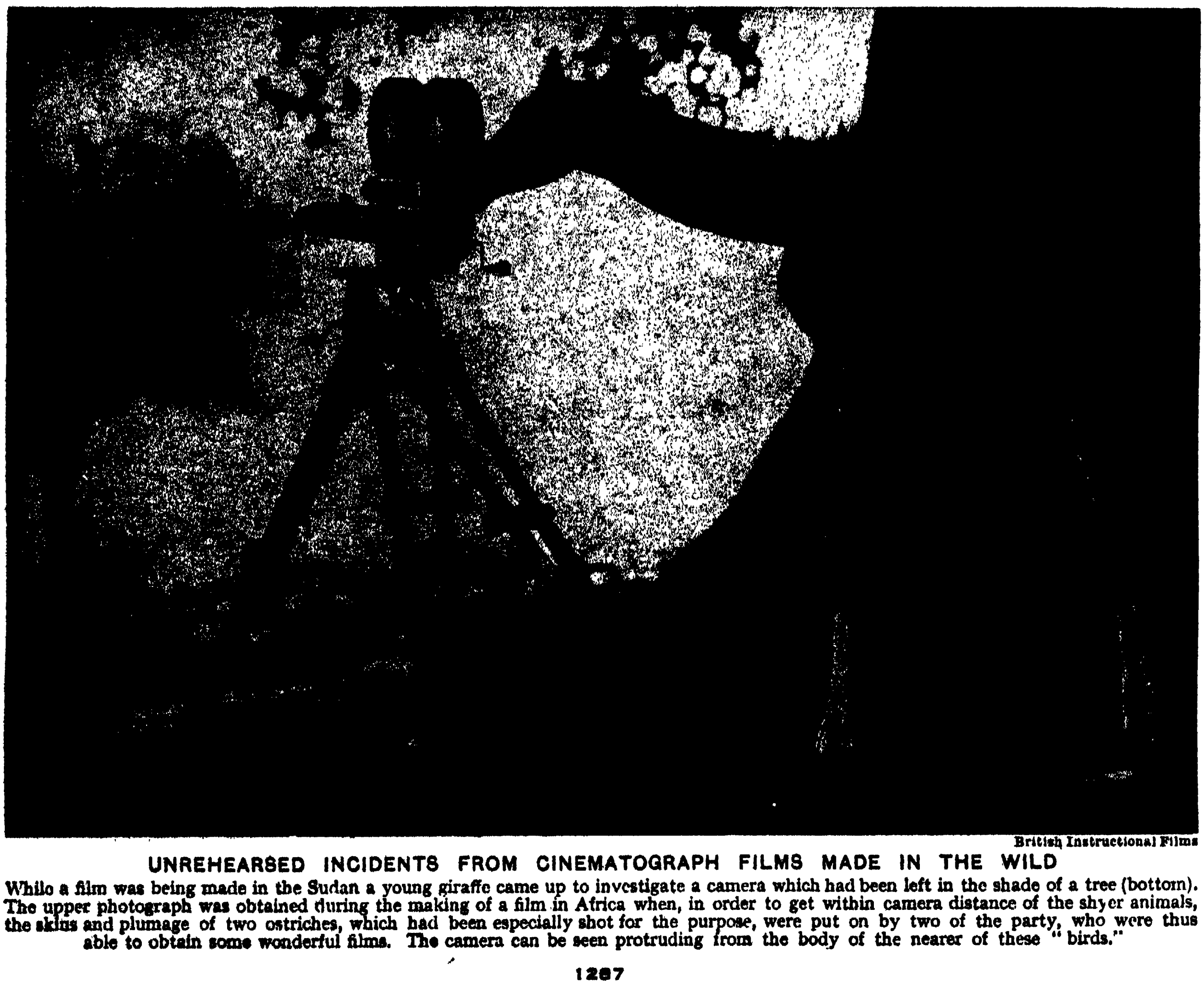
As will be shown, caribou will not pass near any suspicious-looking object. Along both shores the fence was carried out, making short cuts across the bays; and after the shores were laid the slim enclosure was completed by running a line of boughs from shore to shore across the centre of the lake. There then remained open, to any animal that might enter the enclosure, only the narrows leading into Sand Lake, where I and the camera would be hidden.

It was night when we had finished and returned to camp. Camp was made snug against the keen wind and bitter frost by building the usual barricade of spruce boughs and snow in a half-circle, backing the wind, and within the circle, just beyond the length of an outstretched man, a great log-fire was built to blaze merrily, and to die out long after the fur-blanketed forms had gone to sleep. All the ten sled-dogs were tied up this night—an unusual proceeding—to keep them from wandering to the traps on Philip's line, and from chasing any caribou that they might scent in the night. They were then given the whole of a caribou that had been killed and twenty frozen fish—a repast intended to keep them quiet on the morrow.

The following morning we were moving about camp before daylight, preparing in earnest for deer-stalking. Any of the dogs that showed inclination to howl or whimper was securely muzzled with rope; the morning fire burned low; the ordinary quiet voices of the Indians sank to hushed whisperings—those precautions even although our camp was well back from the shore and in the shelter of forest where there was but slight likelihood of smoke or sound reaching the senses of any animals that might approach.

A hide for the camera and myself was built of spruce boughs on the outskirts of the point of land, and commanding the lake at the entrance to the narrows where the caribou were expected to pass. The hide was built as small and insignificant as possible, and the outside, that which might be apparent from the lake, was sprayed with snow until it resembled the natural surroundings. The first two hours of daylight passed uneventfully, and it was not until about ten a.m. that two caribou were sighted. These animals came on to the ice south of the narrows—they had come off the shore past the camera—but the cunning Indians had foreseen the possibility of this, and a few spruce boughs barred the narrows some distance beyond my outlook. At this fence the two caribou were turned, and after a long wait they began to approach the hide. Of the leading buck I obtained one good exposure, and though slight was the click of the release the animal heard it, and swung round as if he had been shot at; there he paused for a second, proud head up and great eyes alarmed, while I remained motionless; but in a moment more he turned and retraced





British Instructional Films

UNREHEARSED INCIDENTS FROM CINEMATOGRAPH FILMS MADE IN THE WILD

While a film was being made in the Sudan a young giraffe came up to investigate a camera which had been left in the shade of a tree (bottom). The upper photograph was obtained during the making of a film in Africa when, in order to get within camera distance of the shyer animals, the skins and plumage of two ostriches, which had been especially shot for the purpose, were put on by two of the party, who were thus able to obtain some wonderful films. The camera can be seen protruding from the body of the nearer of these "birds."

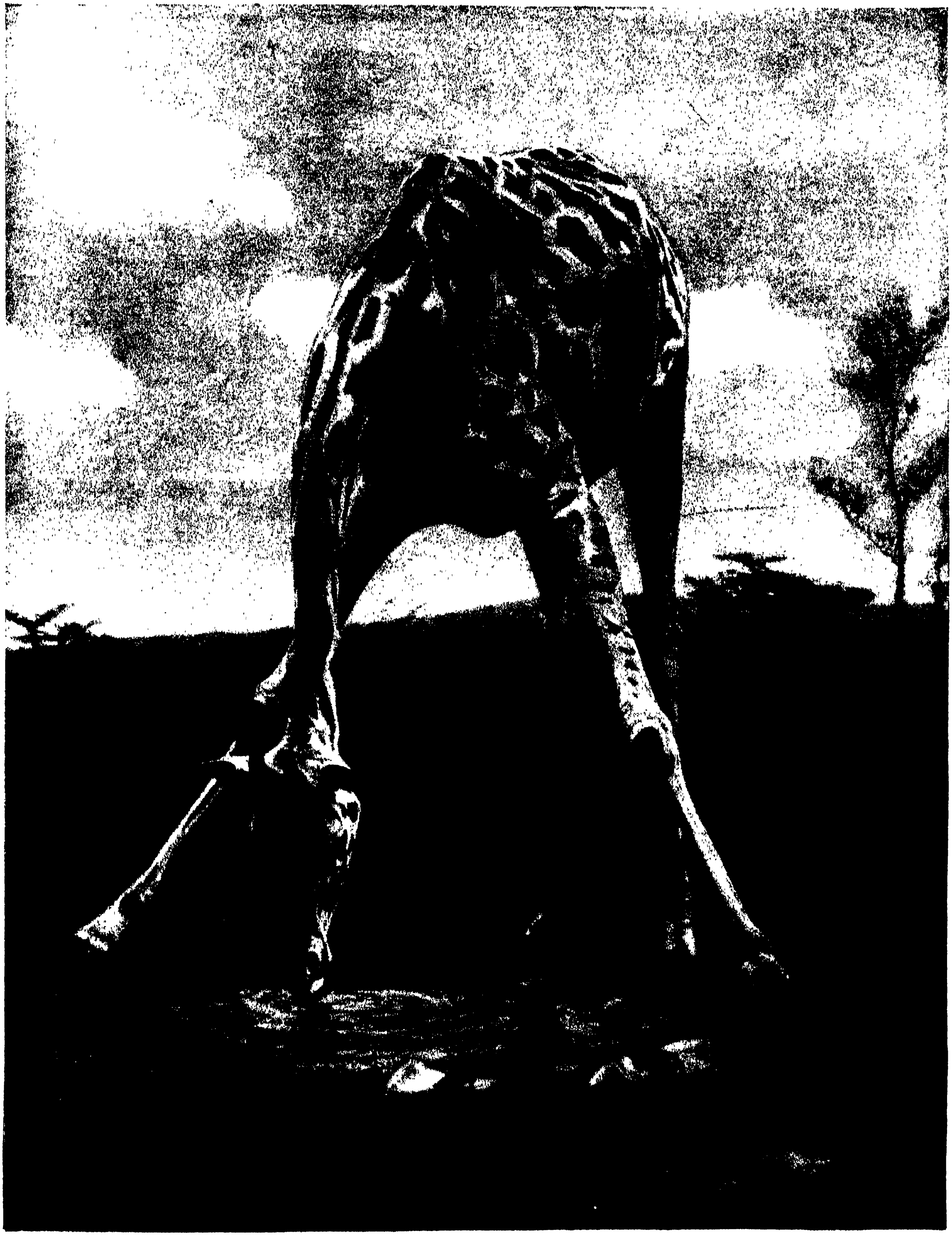
JUNGLE SNAPSHOTS: LIONESS AND ONZA

Whether the lioness or the photographer was the more surprised at the circumstances of this photograph (bottom) is not known, but the lioness seems to have been more effectually frightened since the camera-man lived to develop his photograph. The upper illustration is of a cat-like animal called the onza which is only found in Central and South America.

his steps, smelling the ground suspiciously, while his companion followed.

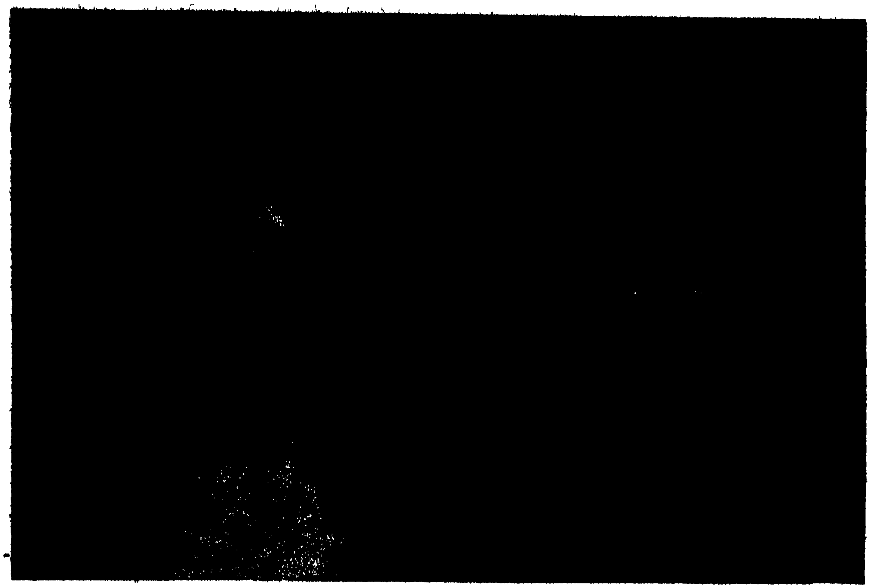
After this there was a long period of patient waiting —not an easy matter in the numbing zero cold—and it was noon when the next caribou were seen. It was then a small herd of a dozen came on to the lake, and within the enclosure, from the west shore. They were very nervous, probably because of the " fence," and they made one or two short rushes as if they meant to risk galloping through the barrier that lay across the lake, only to come to a halt in the end, and to look about wonderingly. The wind was from the north, hence their inclination was to get beyond the fence across the lake; but each time they " funked " crossing between those harmless bits of spruce.

Twice the buck that was the leader came half the distance forward to the narrows only to turn back again to the north-west, and mingle with the others in frightened bewilderment. Finally, the buck made up his mind, and came for the narrows at a long-reaching trot, neck outstretched, head up and horns lying back over the shoulders. Without a halt he came right on, and I allowed him to pass unmolested—he was well ahead of the others —then made some exposures of the following line of does and fawns that filed past the hide. They were fine fat deer, Philip decided, after they were past—he had, in his keenness, come quietly beside me to watch also—and he ran back to camp for my rifle to shoot them, but luckily they were gone ere he returned and he couldn't spoil by the noise of shooting what chance there might be of other animals approaching. However, it was then getting late, and the light was failing, and we were on the point of leaving off for the day, when Philip, who had been moving around the shore



GIRAFFE "SHOT" BY THE CAMERA AT A WATER HOLE

Water holes, often made by elephants and used in turn by all the other animals of the district, are the best places at which to try to photograph wild animals. But the giraffe often lives in very arid country and seems to be able to exist for weeks together without water. This, then, is an especially remarkable piece of good hunting with a camera. The animal's forelegs are so long that they have to be splayed for drinking.



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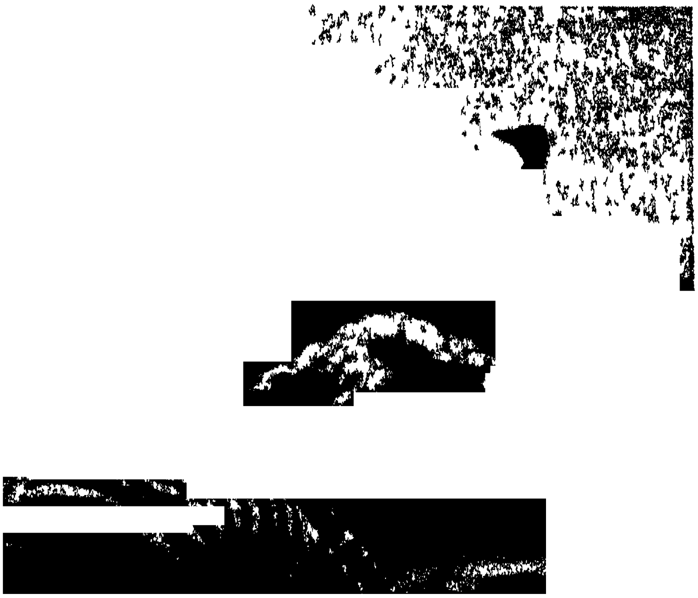


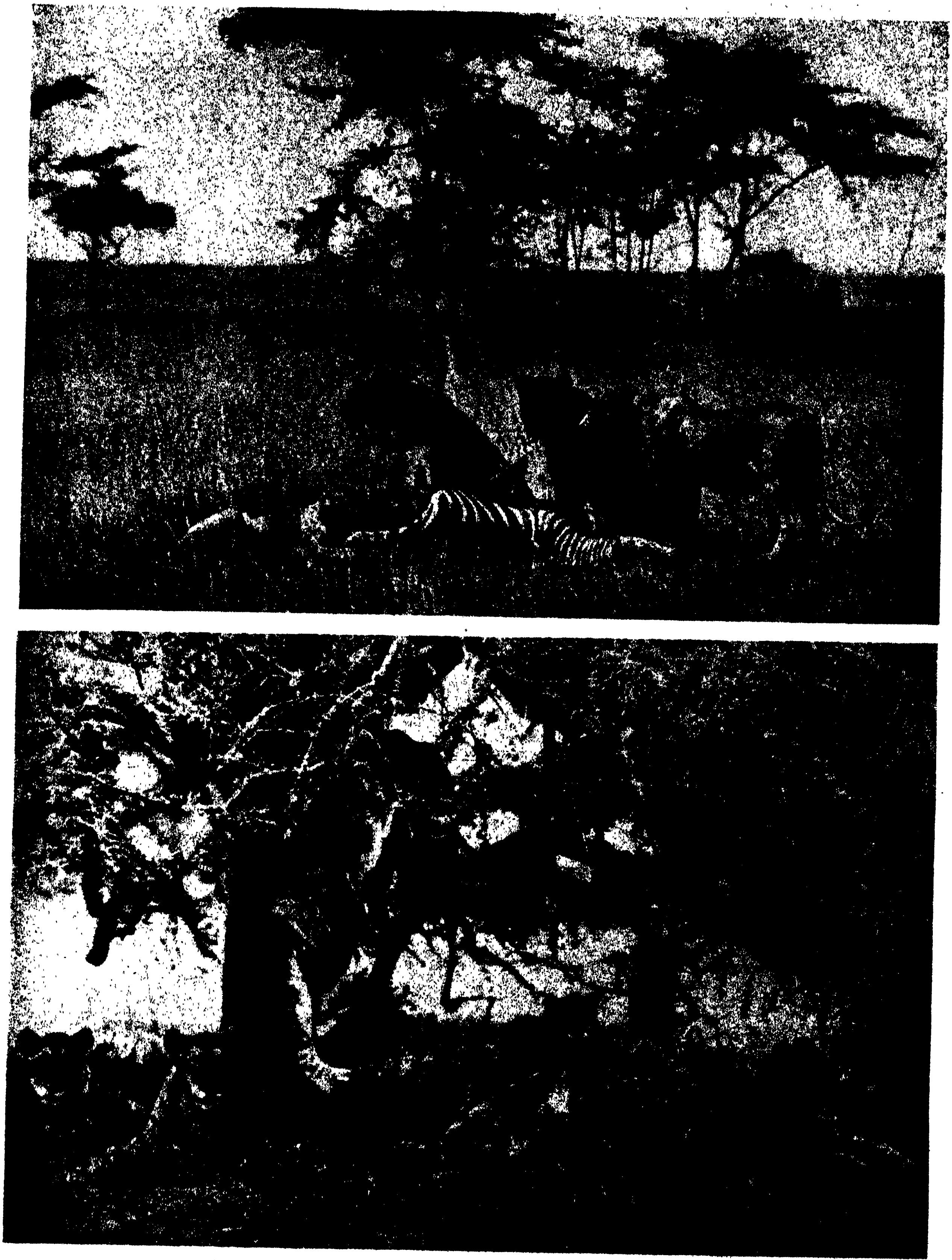
OSTRICH, ZEBRA AND ARMADILLO CAUGHT UNAWARES

From wonderful South Africa comes the lower photograph which seems to show some incongruous acquaintanceship between an ostrich and a zebra, which are both feeding together as though they enjoyed each other's society Above we have an armadillo caught in the act as it came down to a pool to drink Rarely are photographs obtained of this animal actually in the water

a little way, came to tell me that a single fawn was approaching. This animal walked all along the fence, smelling the ground where the others had previously passed, and uncertain where to go. Finally it got on the fresh track leading to the narrows and came ahead quickly. As the animal passed I made two exposures, though the light was by then very poor and the result uncertain.

It was now three p.m. and too dark for further camera work. It had been snowing lightly all day, and the light was not very good for making rapid exposures. However, what was really worrying me was the action of the intense frost on the focal-plane shutter. Twice it had absolutely stuck in the middle of an exposure, and twice, also, it had refused to act at all when beautiful caribou pictures were possible. I was beginning to fear the shutter was going to spoil everything, and that I wanted a very simple instrument to replace this complicated mechanism, to which tiny frost particles clung and jammed the finer workings Over the evening camp-fire I spent an hour trying to prevent any recurrence of a hitch in the shutter-workings Before the heat of the fire it worked perfectly, and I laid it aside in the end with renewed hopes for the morrow.

There you have most of the elements assembled that make up the quickening excitement in wild-life photography, the scheming to outwit wary game, the care and detail of preparation, the long waiting, the thrill in a real success (which is yours perhaps *once* after weeks of trying), and, above all, the pleasure of being very close to Mother Earth among shy creatures that are given to seek the silent nooks and hidden dens of solitudes furthest from man and nearest to the cleanliness of God



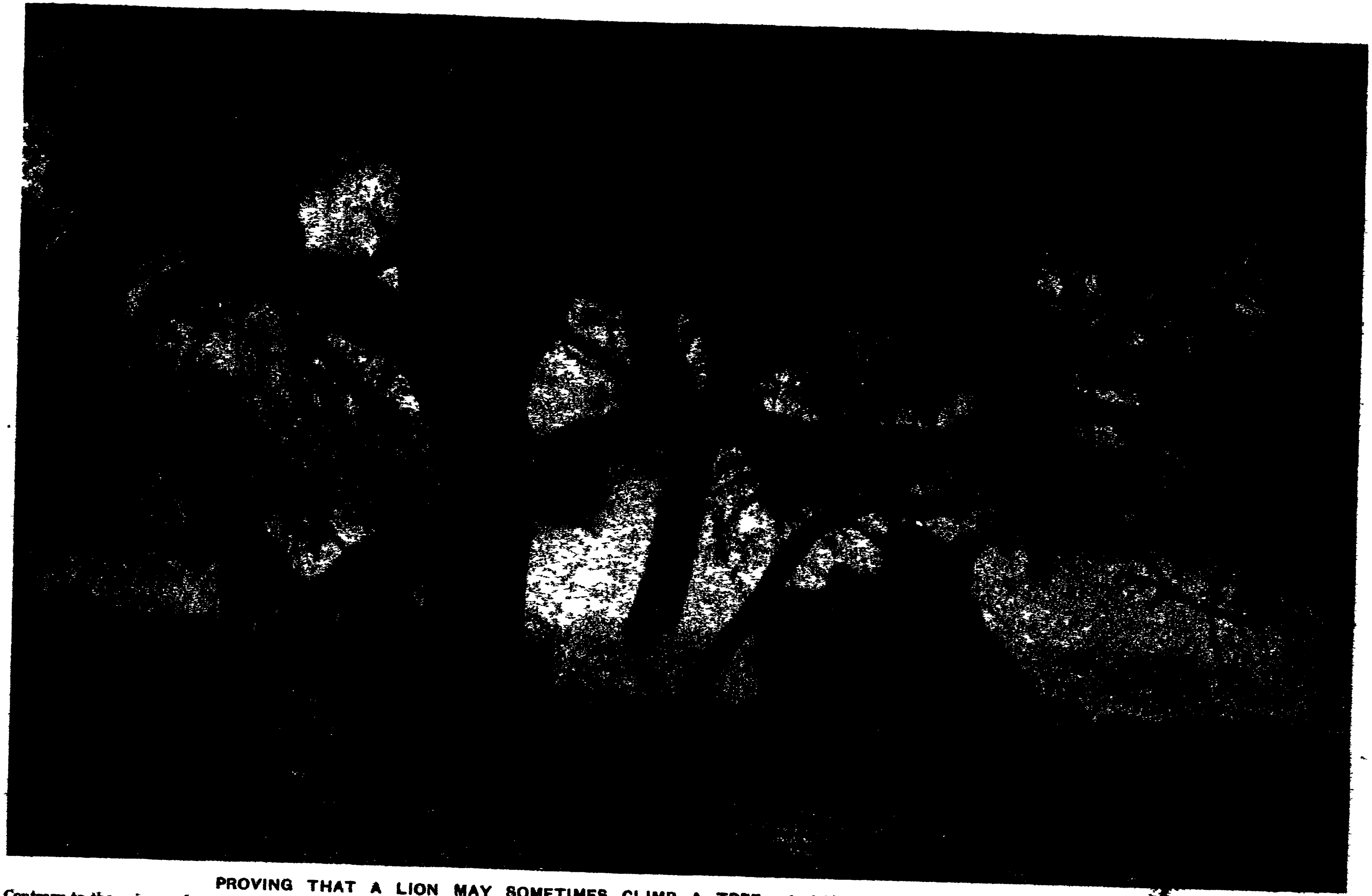
GROUPS OF LIONS—BUT IN THE WILD NOT THE CIRCUS

While it is a pleasant thought that men can now go out and hunt wild animals with a camera and not a gun it is much more so from the point of view of the person who reads about it than the photographer. Because the lion, for instance, is just as well armed as usual and objects as much to a camera as a rifle. Even with a crack shot beside the camera it must be nervy work obtaining such photographs as these. In the upper photograph, taken by Col. Maxwell, there are two groups of lions, one in the foreground discussing a dead zebra.

Col Maxwell

UNUSUAL SPECTACLE OF A LION THAT HAS CLIMBED UP INTO A TREE

This photograph is remarkable for showing a lion that has partially climbed up a tree and was taken by Col. Maxwell in Africa. In this connection it is interesting to learn that, at the London Zoological Gardens, an experiment was tried in the lion house. An arrangement of branches was fixed on a platform in one of the outdoor cages so that the lion had to climb for its meal and get the benefit of a little exercise. It was not realized till recently that lions did climb trees but every year courageous men extend our knowledge of natural history.



PROVING THAT A LION MAY SOMETIMES CLIMB A TREE: A LION GROUP ENJOYING A SIESTA

Contrary to the opinion of many hunters and naturalists, who supposed that lions never resorted to tree climbing, it is now proved that these great animals both can and do climb trees sometimes. Indeed it would seem strange if a member of the cat tribe were unable to climb. This and two of the preceding photographs, all by Col. Maxwell, show that the case is now beyond dispute. One of the lions in this interesting group at ease beneath a tree, has climbed on to one of the stronger branches and is enjoying the rest with the others, the tail hanging contentedly down without so much as a twitch. In fact all the group look as though they were enjoying a lazy afternoon, though some of them have been attracted towards the camera. This photograph and those on pages 1290, 1291 and the top photograph on page 1296 are by Colonel Maxwell and were published in "The Times."

There is one other element, not directly apparent in the above, the element of danger. In wild-life photography abroad it takes two forms: danger from climate, or danger from an infuriated beast. To my mind the danger of climate is the greater. When the weather goes wrong and storms break loose the strength of the man who, from necessity, sleeps out-of-doors on the bare earth can be very small against the fury of the blizzard or hurricane or intense set of temperature.

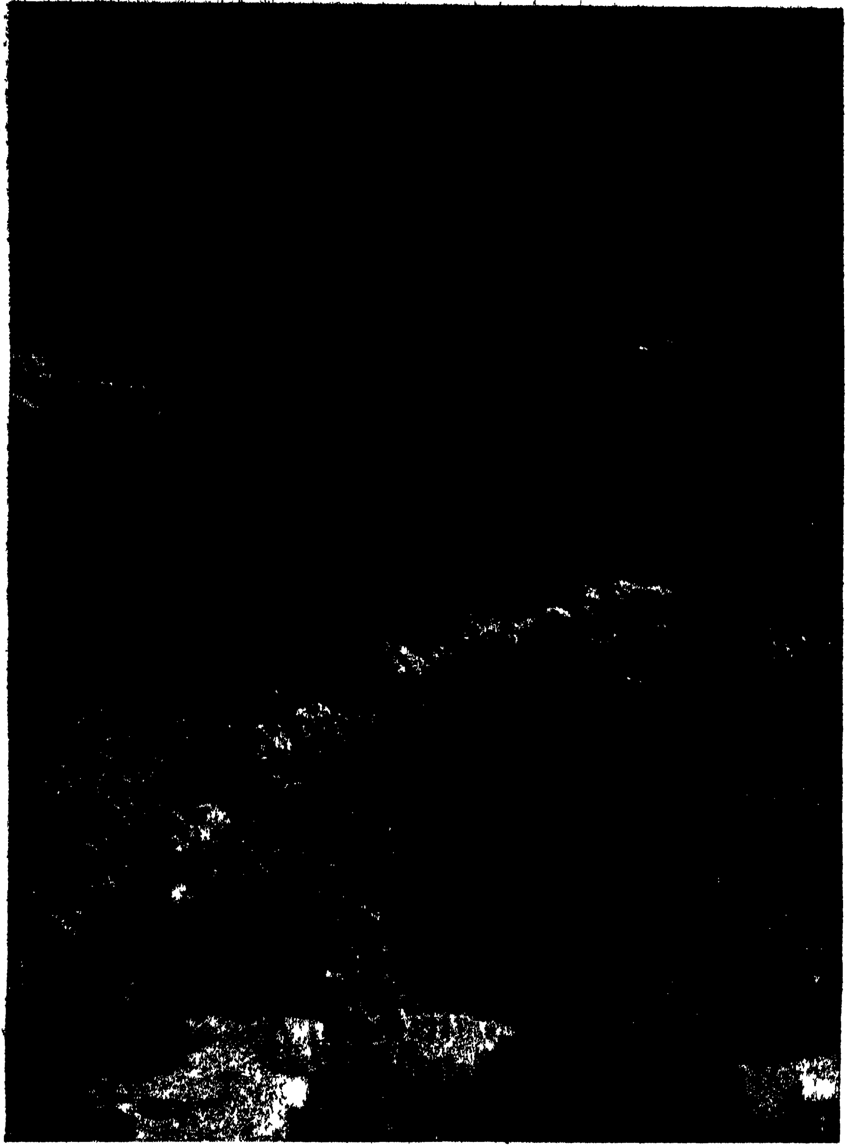
CONCEIVE the land where my caribou pictures were taken. Travel for months was necessary, through a vast white land of silent snow and piercing cold, to reach the place where the animals were to be found. Sometimes we were smothered by awful blizzards of snow and had to stop travelling altogether, to shelter round our sleds like waifs. The giant elements of heartless cold that was always with us, the dumb, boundless ice-locked, snow-smothered land appalled the stoutest heart. At times it seemed preposterous that against those forces such little things as we, mere dust-specks in such mighty company, should dare to go on, and go on. Indeed, within you you are almost sure the overpowering forces will get you in the end, some day when you go just a little too far and are contemptuous for an hour of its antagonism.

The danger of being attacked by an infuriated animal is, in my experience, a far less constant danger. It is a swift sensation of the moment, unlikely to happen more than once or twice in a lifetime. I would rather the quick blow and the quick settlement than the blow that hangs over one's head perpetually and demands that you shall endure.

I have only once been seriously charged by an animal, and that a wounded caribou, one of the least expected of beasts. I have been rushed by both elephants and rhinoceros in fairly thick bush country in Africa, yet I am convinced that in every case they were far more anxious to get away than to harm me, though they dived past within arm's length.

Generally speaking, wild animal sense has an inborn fear of the human smell or touch. I have myself seen the lion, in some situations the proud king of beasts, sneak off at my approach as shamefully as a guilty cat. At the same time, it is far from my mind to advocate that anyone can afford to take liberties in photographing our greater game. There is always a certain tense element of uncertainty and risk, and disasters of the past have proved to the world the full penalty the hunter may pay, even in face of long experience and calculated prudence.

With regard to nastiness in animal temperament I rate the cow elephant, with young, and the African buffalo by far the most dangerous of all wild animals for the hunter to interfere with if they show the slightest sign of being in a mood to be roused. Turning to another aspect of animal temperament;



W Lowther Kemp

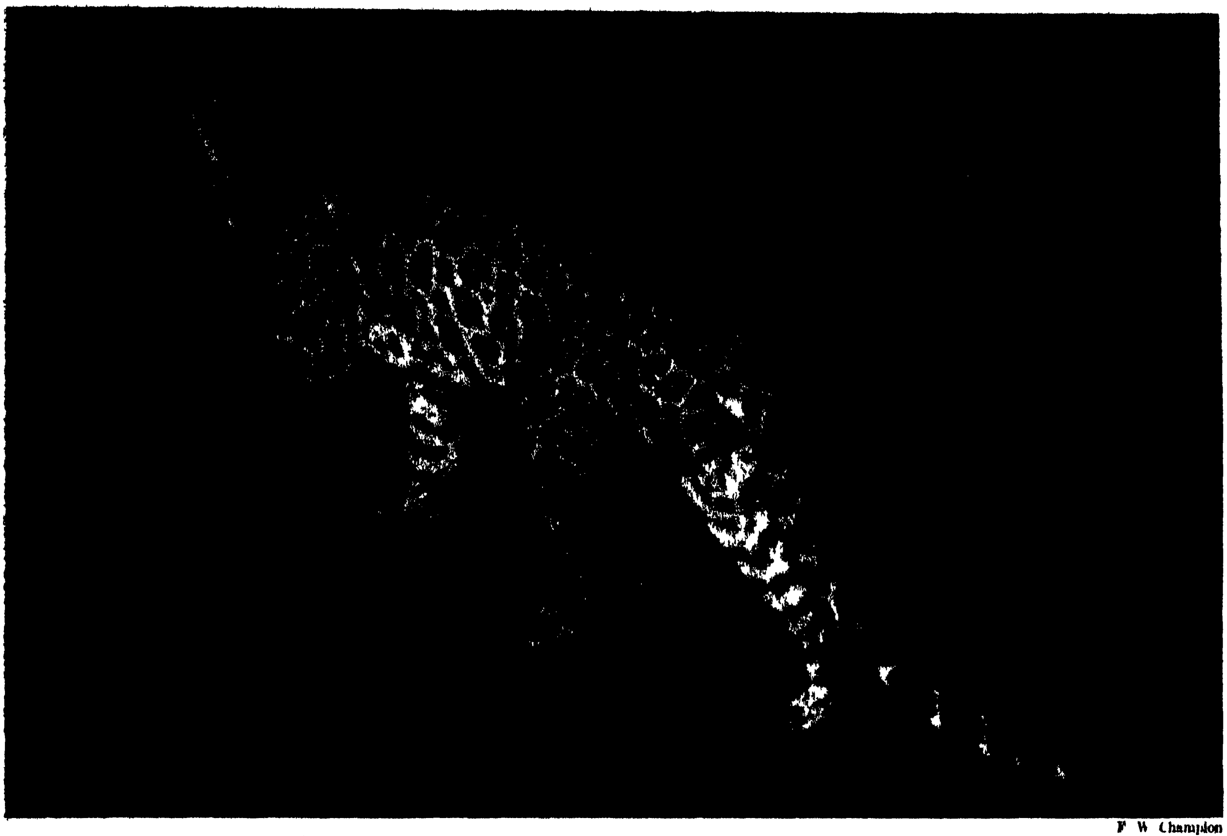
SEVEN LIONS PHOTOGRAPHED IN INDIAN FILE

After a wait of an hour and a half, the photographer was rewarded by the marvellous sight of nine lions walking in single file. When within range, he operated the shutter but, at that moment only seven were actually in view. The one bringing up the rear may be seen in the distance. The next two in front of him had momentarily become hidden by the bush

Keystone

THE PUMA IN AMBUSH AND THE CROUCHING LYNX

While the rifle taught us, indirectly, a good deal about wild life, because big game hunters had to study the habits of their quarry and an examination of the dead animal, when shot, added new data to the scientist's note-book, yet the camera can carry on the lesson and supplement it without destroying the subject. Our lower photograph reveals a puma hiding behind a big boulder in the Colorado mountains in wait for passing game. Above is a lynx, fiercest of American carnivores, crouching in a thicket.

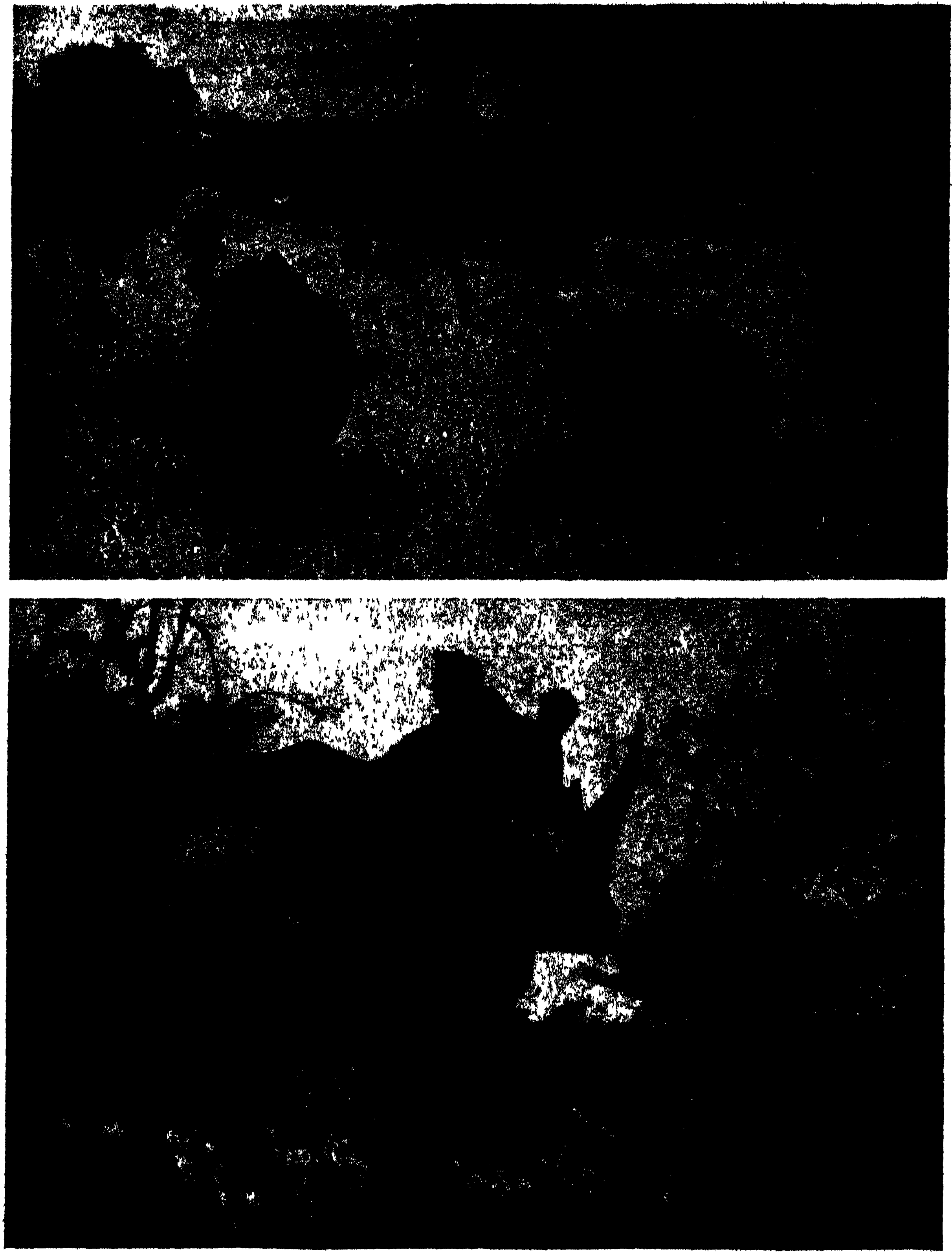


F W Champion

F W Champion

WONDERFUL FLASHLIGHT PHOTOGRAPHS OF TIGRESS AND LEOPARD

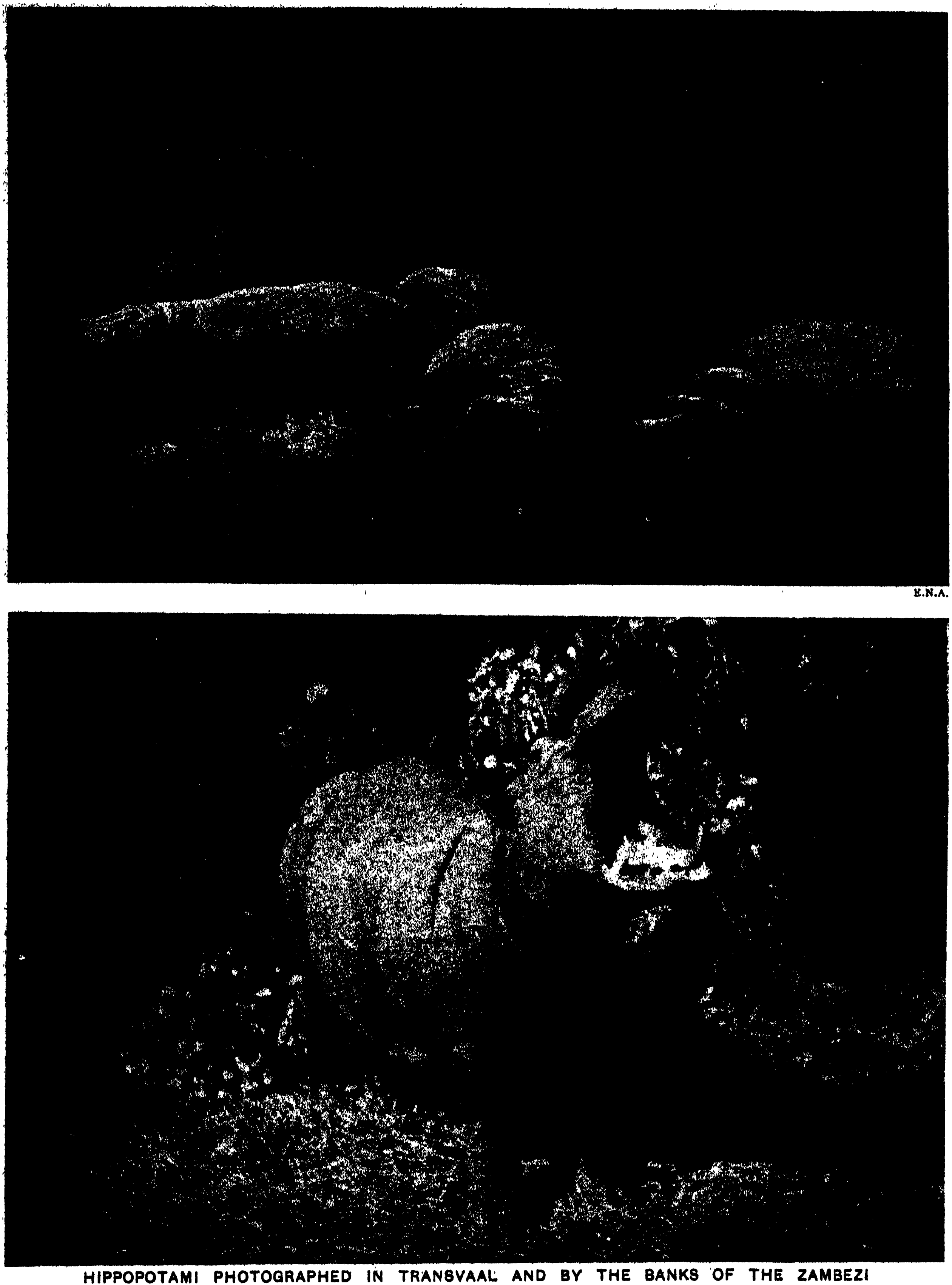
Taken in the Indian jungle by night, these two illustrations are fine examples of the result of many hours of preparation and careful watching—the reward of a first-rate photograph The tigress (bottom) was stalking through a path in the forest during her night's hunting, while the leopard was coming up from the pool where it had been drinking If the leopard gets a taste for human flesh it is considered even more dangerous than the tiger, although it is neither such a heavy nor such a powerful animal



Herbert Lang

ALMOST EXTINCT WHITE RHINOCEROS AND A COW RHINO WITH A CALF

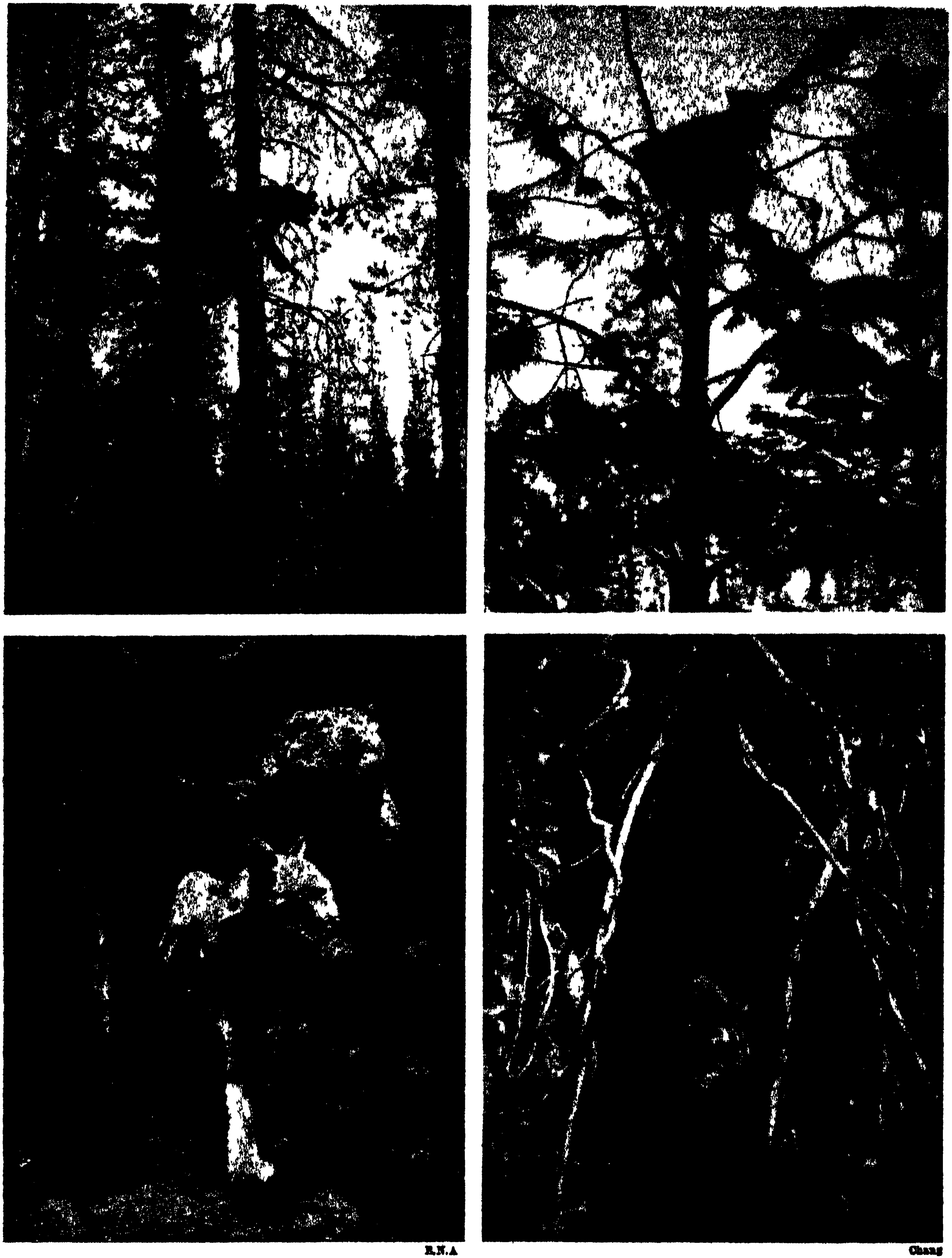
At the last hour, as it were, attempts are being made to save the white or square-lipped rhinoceros from extinction. Thousands used to live in the territory of the Union of South Africa, while now it is believed there are only about twenty individuals left. This photograph (bottom) was taken within fifteen feet of the animal, a bull. The territory in Zululand which is the last refuge of these great beasts has been abolished as a game reserve. Above is an ordinary rhino cow, with her three-parts grown calf, photographed by Col. Maxwell.



E.N.A.

HIPPOPOTAMI PHOTOGRAPHED IN TRANSVAAL AND BY THE BANKS OF THE ZAMBEZI

A hippopotamus does not look a war-like animal, but it is not, nevertheless, to be trifled with, for it can run at considerable speed and anyone who approaches near enough to obtain a photograph such as the lower of these two certainly runs a risk. But if the hippo is to be watched carefully on land, in the water (top) it is a much uglier antagonist since it can crunch a canoe in its enormous jaws and upset a much larger boat by coming to the surface underneath the keel. The group seen above is in the Zambezi.

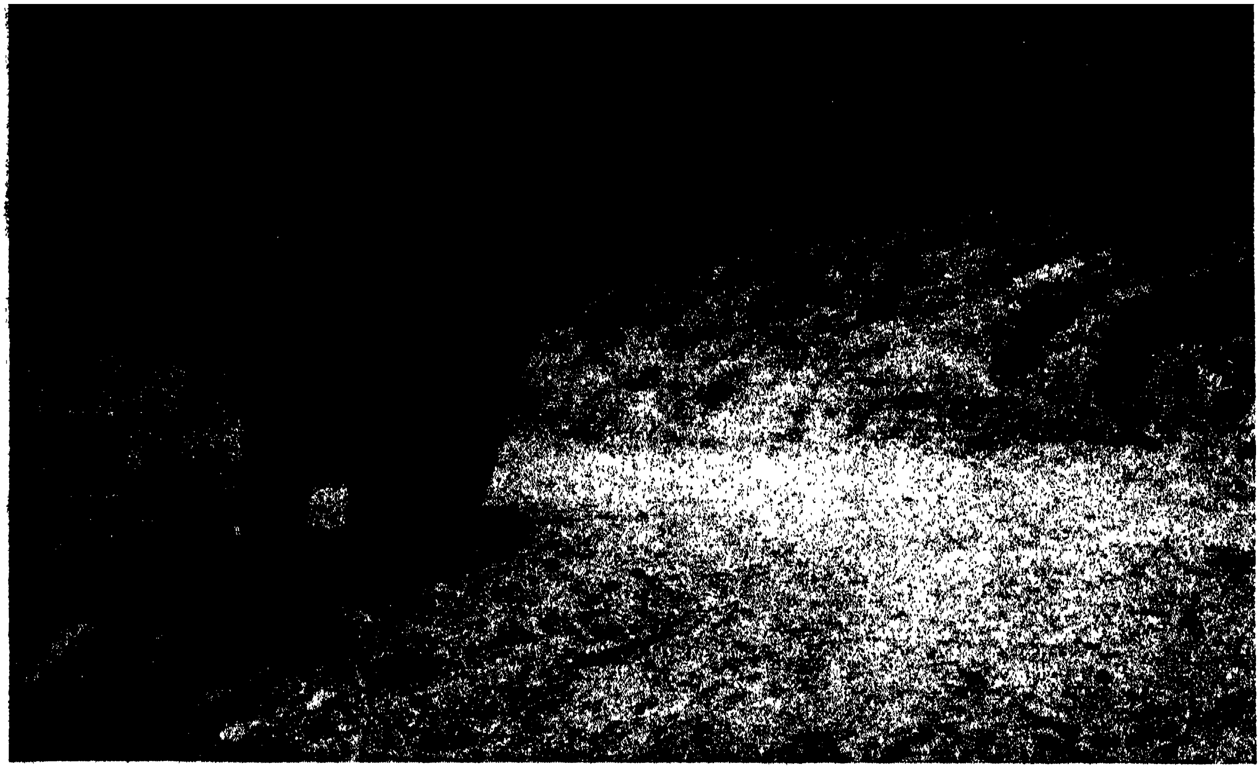


R.N.A

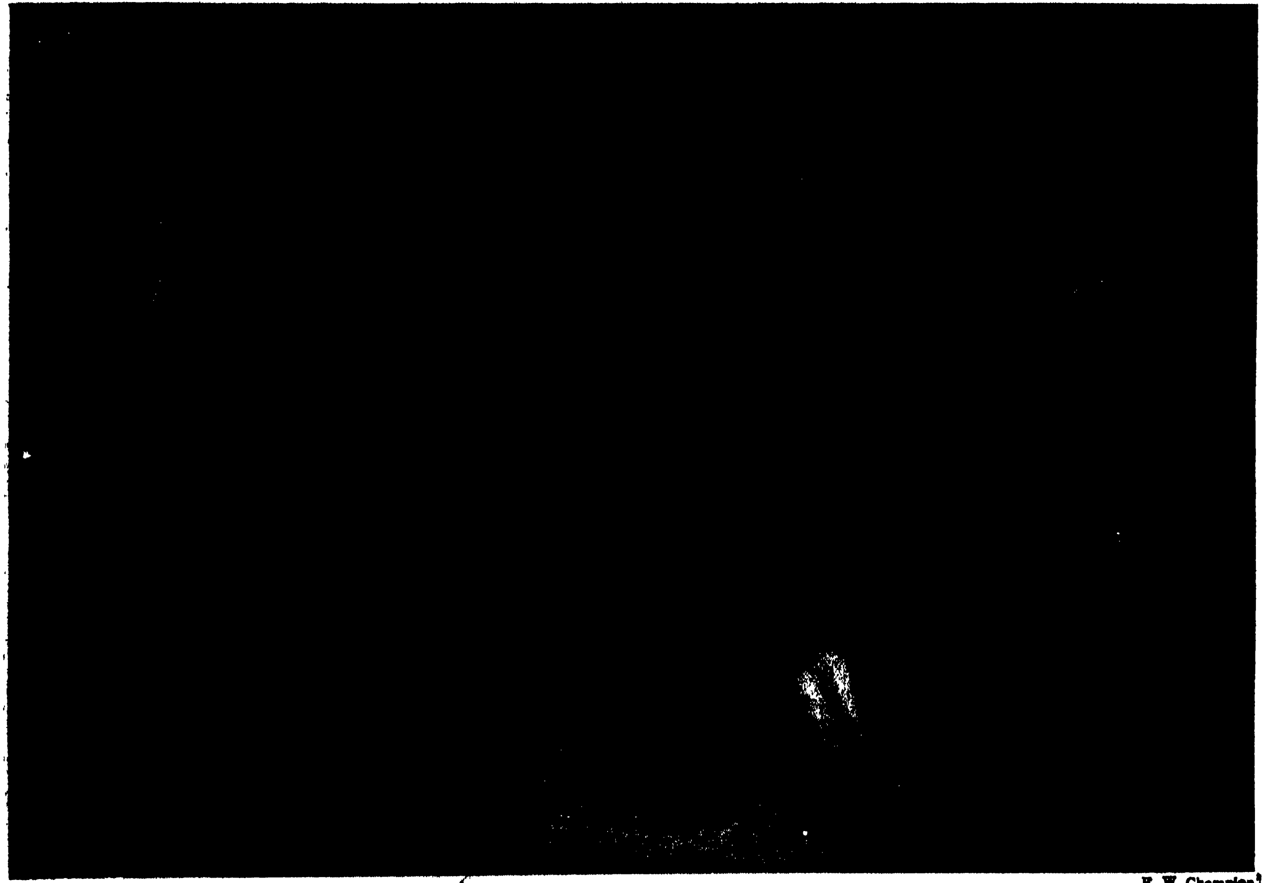
Chang

PUMA, TIGER AND BEAR CAUGHT BY THE CAMERA

In the lower left-hand illustration we see a puma. Its lair was discovered and the photographer lay in wait and succeeded in getting a picture of the animal just as it emerged. On the right (bottom) is a fine tiger regarding the camera with a dreadful hatred in its eyes. Notice how, as it stands in a sort of cavern in the thick jungle, the branches cast shadows upon its striped hide. This photograph is from the film "Chang." Above we have a bear and a puma "snapped" while climbing trees.



H. J. Shepstone



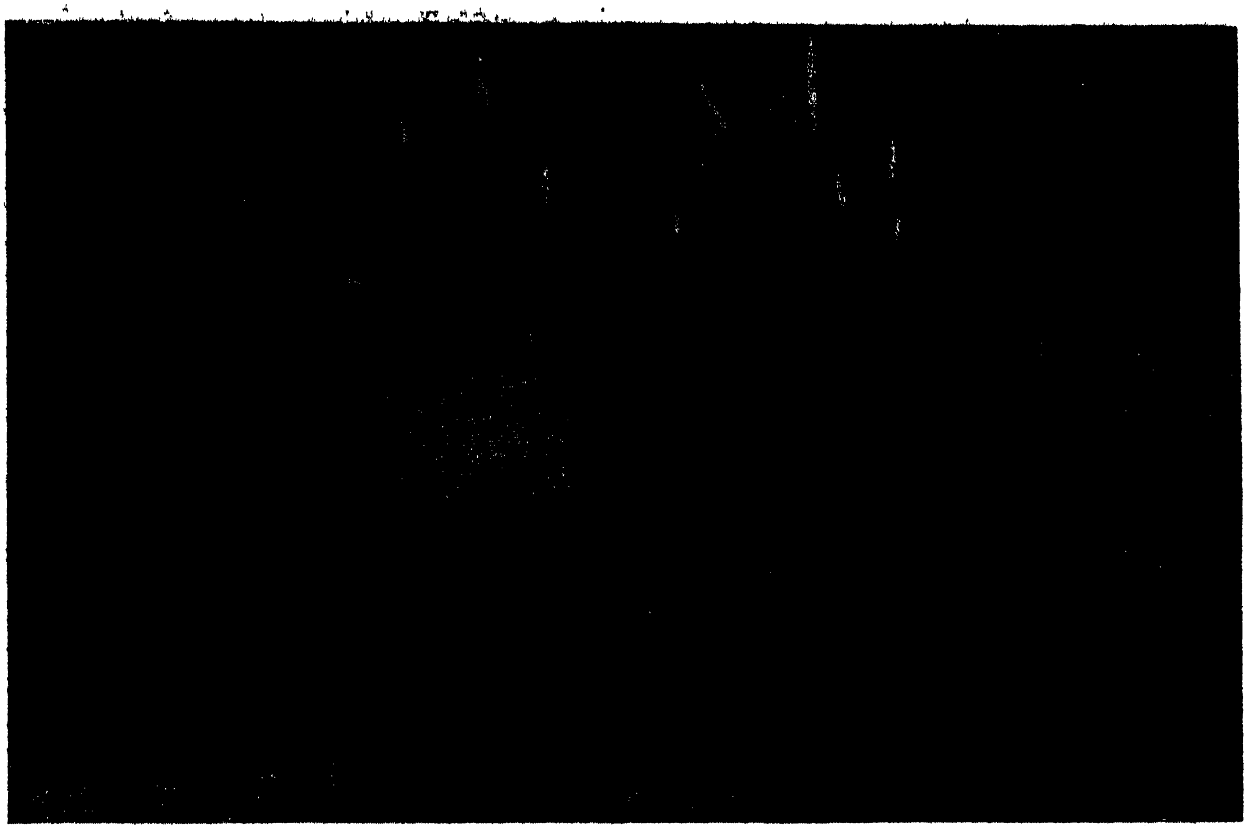
F. W. Champion

SLOTH BEAR, A HORRIBLE DANGER OF THE INDIAN JUNGLE: AN AMERICAN BEAR

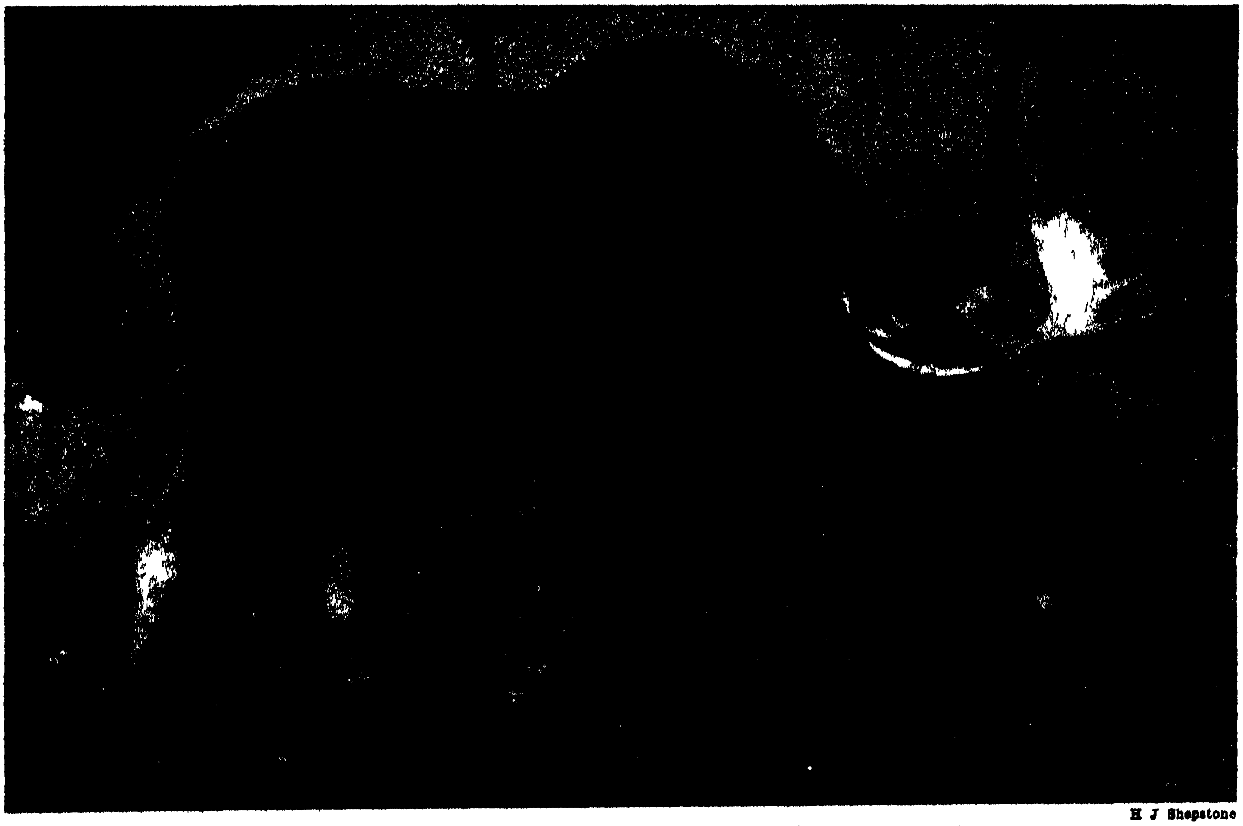
Save for leopards and those few tigers that are man-eaters, the sloth bear (bottom) is considered the most dangerous animal in India. It is not vicious tempered but its sight and hearing are both poor, and some villager may approach one of these animals unknowingly. The bear does not become aware of the man's approach and move off, as most other animals would, but is suddenly surprised at a short distance, and, in its fright, may scalp or blind a man with a blow before it flees. Above is a bear in a forest in North America.

ZEBRA AND GAZELLE AS THEY COME TO THEIR DRINKING PLACE

In some parts of Africa where water is rare, every animal in the neighbourhood must visit a certain drinking place within a day or two. The water holes are therefore excellent places for the photographer's purpose. Below we see some zebra beside a dried-up stream. Here the term water hole is literally true and we can see two of the animals drinking at small holes in the ground in which some water has oozed up in the neighbourhood of the parched stream. Above is a nervous company of gazelles.



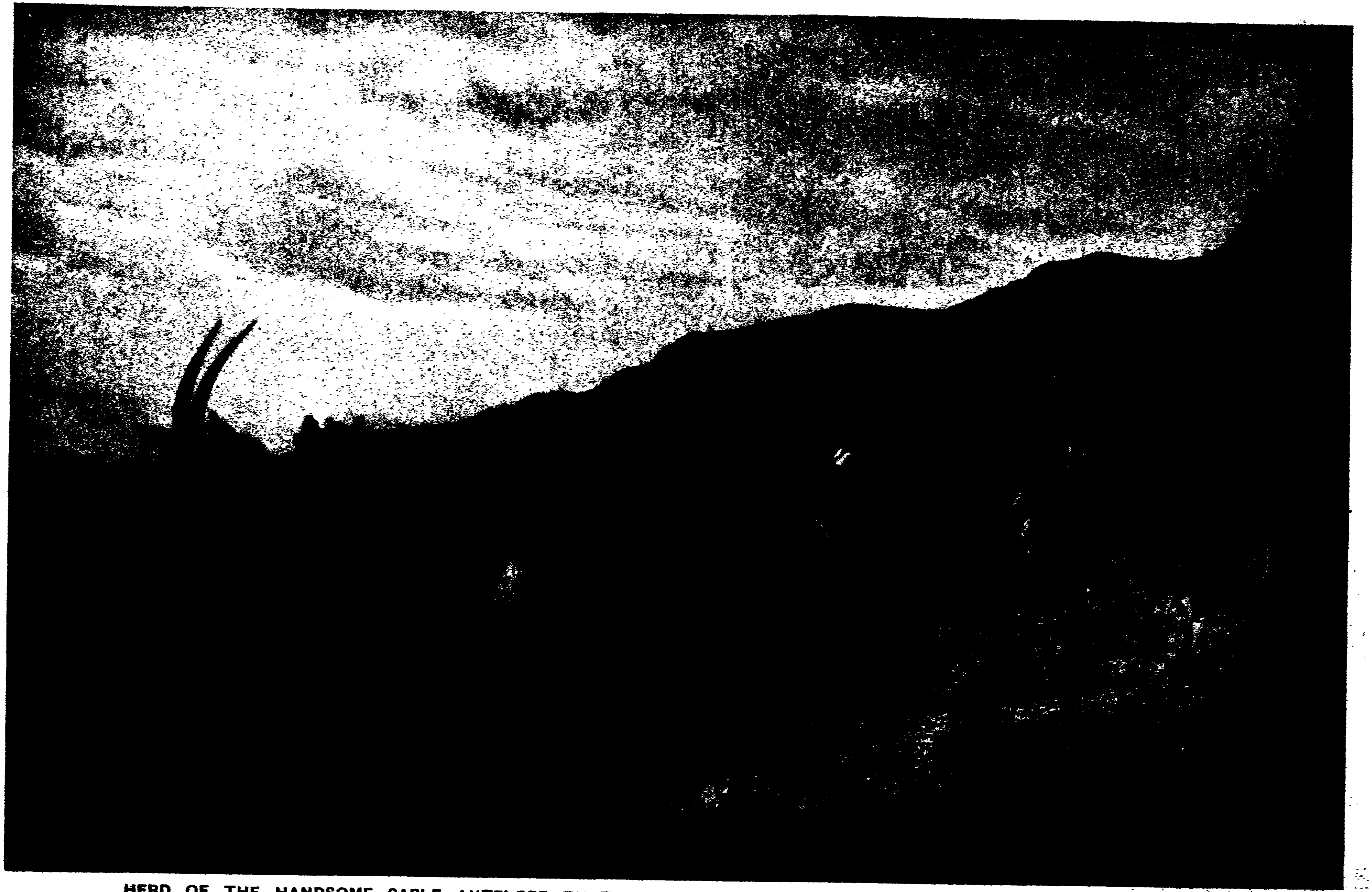
H J Shepstone



H J Shepstone

BIG DEER THAT ROAM NORTH AMERICA: MOOSE AND WAPITI

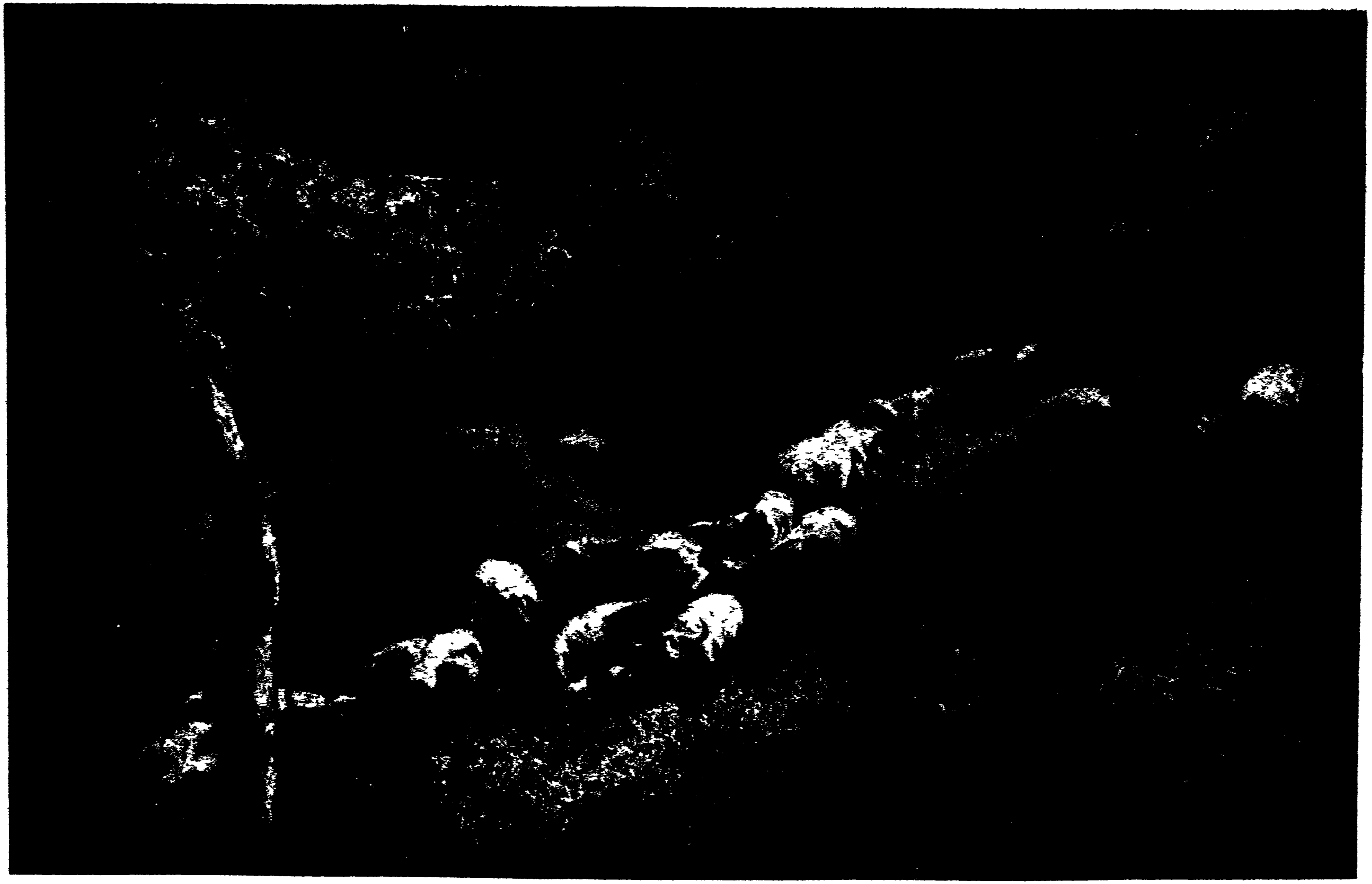
Naturally very shy and made more so by much hunting the moose (bottom)—sometimes called elk in America—is not an easy subject to obtain for the camera. It lives in the loneliest forests, usually on high ground, during the winter time but comes down to the swamps round lakes in the summer. A bull may stand seven feet or so at the shoulder, for the moose is very long in the leg. The wapiti (top) is a big and handsome deer allied to the red deer of Britain, and is now getting scarce outside the state reservations.



Autotype

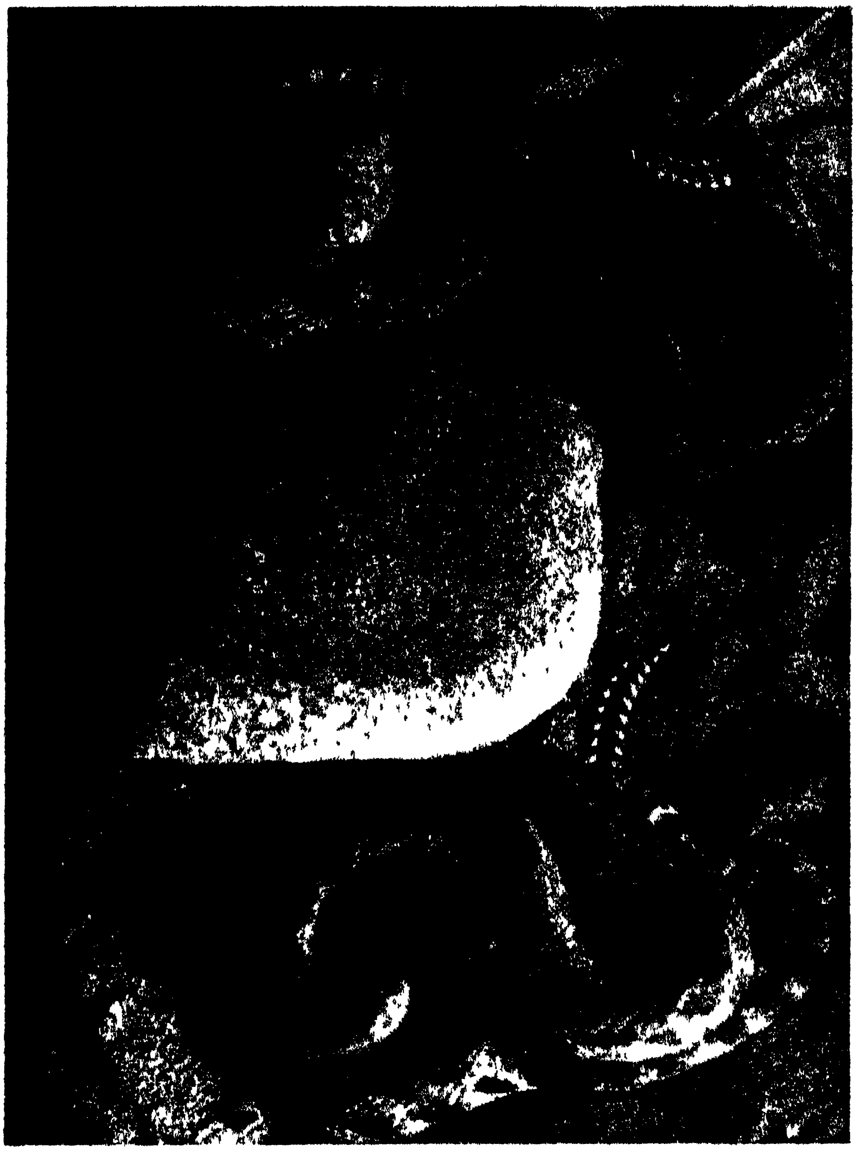
HERD OF THE HANDSOME SABLE ANTELOPE THAT RANGES THE WILDS OF AFRICA FROM UGANDA TO RHODESIA

Between Uganda and Mashonaland is the range of the handsome sable antelope. It keeps to moderately wooded country avoiding both thick forests and open plains and never goes far from water. The herds are usually not large, twenty cows running with a single adult bull. It is very rarely that a herd is seen with more than one full grown male and it is thought that the supremacy of the herd is fought for very fiercely. However, the herd may be so small as to comprise only ten or a dozen other members, while, on the other hand, fifty may run together. The bulls are very dangerous when hunted and even if brought to the ground by a wound, continue to fight with vicious strokes of their long, pointed horns.



MOST DANGEROUS ANIMALS IN AFRICA: HERD OF BUFFALOES IN A SECLUDED FOREST GLADE NEAR NAIROBI

Seldom can a man approach as near as this to a herd of these animals. Hunters are agreed that the African buffalo is, when wounded, the most vengeful and the most cunning of wild beasts. It will even feign death if, by that means, it can lure its enemy within killing distance. Other animals can often be frightened away or stopped temporarily by a bullet, but it is only death that can stop the buffalo when once it has decided to charge. This remarkable photograph, taken in thick cover not far from Nairobi, by Colonel M. Maxwell (and published in the "Times") shows an unsuspecting herd browsing peacefully in a tropic glade. One animal is looking up in the direction of the photographer's "hide" as though it suspected something.



Shepstone

DANGEROUS TO PHOTOGRAPH! COILED RATTLESNAKES

Rattlesnakes are found in North and South America, but especially in the dry desert districts of Arizona where they lie, concealed by their protective coloration, amid stones and dust. Their bite is extremely dangerous, and to get a camera within close range means taking a risk indeed The snake in the foreground seems to be waving its rattle in a threatening manner.

as a rule animals that graze, such as giraffe, elephant, antelope, and so on, give the photographer his best opportunity to get results from his hunting, while the cunning carnivorous wolf-like or cat-like beasts have a knack of outwitting one at almost every turn. There is certain quiet confidence about undisturbed grazing big game which gives the stealthy camera-man a chance; but fox, or wolf, or the like, appear never at ease, and even when asleep keep half an eye open.

It is somewhat similar with the nature of birds. Those that flock to the ground, like plover or egrets, or are content on lakes, like ducks, or gather to grain, like pigeons or finches, are possible to photograph, but those that prey, like eagles and hawks, and roam widely, like ostriches and bustards, are tremendously difficult to get within reach of to catch with a steady focus.

Wherefore it is readily seen that wild-life photography has before it a very wide field and is an exacting undertaking. It is a study that no single man can complete in a lifetime; the best he may hope to do is to add some links of knowledge to the work of others before him. Weeks, months, even years may pass without one picture being obtained of a single subject fondly desired. It is a study that absorbs an unbelievable amount of time, when we live in a business age that puts a money value on every working hour of the day. I am sure I am safe in saying that no man ever brought home pictures and got from them profit in money, nor tangible return for his work. The reward lies in it being a labour of love—love of subject—love of surmounting difficulties and reaching out into new fields that we think must grow to bigness in time in the eyes of fellow men who are slow to grasp the majesty of that wonderful creation which has different lights at every boundary of the earth.

When you sit in the luxury of a theatre and see fast-speeding pictures of scenes in other lands, which adventurers only might see in the olden days, you, no doubt, often try to picture the actual conditions under which they were taken. On the screen you probably see the very brightest incidents and scenes; the result of long months of painstaking work. In editing a picture everything likely to be monotonous is left out, yet monotony is prevalent, in fact, throughout all long journeys in the wilderness. You read between the lines and guess so much.

If you picture so much you have a soul ready with sympathy for your fellows. That soul is a very valuable thing even though it is inarticulate.

Photographing wild life entails plenty of hardship and a great deal of patience, but it is an alluring quest, and surely the joy in it is in being privileged to bring a record of other lands for the entertainment of those who are office-tired at the close of an exacting day, and find relaxation and refreshment, even in reflection, of open winds upon the Plains.

Chapter CXIII

Little Animals that might Overwhelm the World

By Dr. J. G. Myers

of the Imperial Bureau of Entomology, London

One of the most engrossing of all the activities of animals is that which is concerned in carrying out the original command to multiply, to be fruitful and replenish the earth. So important does this need appear, and so much does all seem directed to this end, that it has been said that Nature cares nothing at all for the individual, and everything for the race.

Perhaps the most widespread of the ways by which the perpetuation of the species is ensured is the production of abundant offspring, so that however great be the adversity of circumstances and the activity of enemies, at least a few survivors may remain to breed in their turn. Chapman has proposed the term " environmental resistance " for the sum total of the adverse influences of the environment and, carrying the electrical analogy a little further, has given the name " biotic potential " to the inherent power of an organism to reproduce and survive, or to hold its own against the environmental resistance. One of the greatest factors in biotic potential is reproductive capacity. A summary view of the Animal Kingdom will afford us many striking examples of this capacity.

Woodruff kept one of the simple microscopic one-celled animals, a slipper animalcule (*Paramecium*), and observed carefully the rate at which reproduction—in this case by simple division—took place. He maintained this pure stock for five years, and recorded in that period no fewer than 3,029 generations, the average rate of reproduction being three divisions every 48 hours Woodruff calculated that had all the offspring during the period been allowed to survive and reproduce at that rate in their turn, there would have been produced a mass of protoplasm ten thousand times bulkier than the earth. It was estimated further, according to Lull, that at the end of the nine thousandth generation the volume of living substance would have exceeded the confines of the known universe, and would be growing outwards at a rate equal to the speed of light.

H Bastin

CORN BORER MOTHS

Caterpillars of these moths bore into the stalks of maize and do immense damage. But it has been found that only a very small proportion of eggs laid ever produce insects that reach maturity.

Travellers are never tired of describing the beauties of phosphorescence when the sea looks like liquid fire for mile after mile. In many cases this light shines from the pin-head-like bodies of minute and simple animals (for example, *Noctiluca*), of which a single bucket of sea-water contains more individuals than there are people in London.

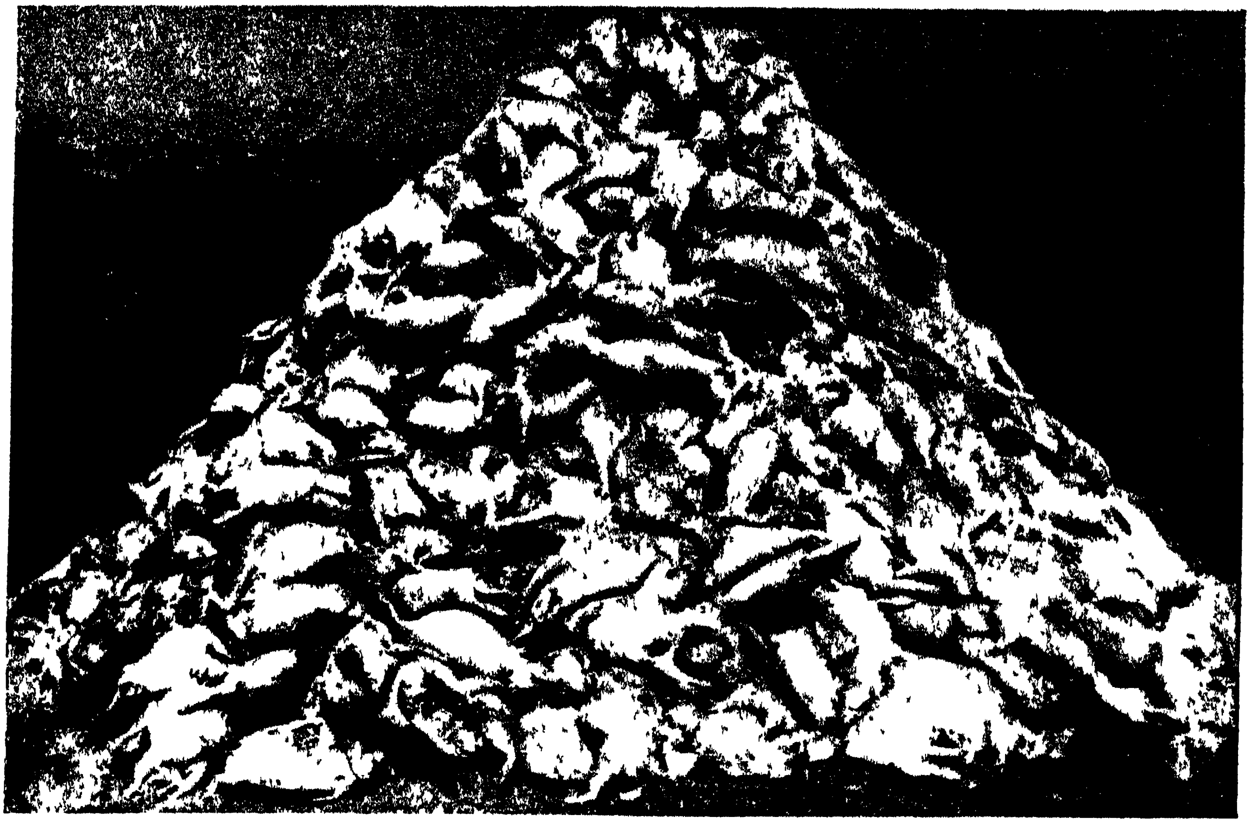
The common tape-worm (*Taenia solium*) of man periodically discharges segments of its body packed full of its ripe eggs. Raillet states that one worm may cast off as many as fourteen of these segments or proglottides every day, and each contains at least 8,800 eggs. Caullery believes the parasitic worm will produce eighty millions of eggs per year.

The queen bee is often considered very fecund, for she has been estimated to lay thirteen times her weight of eggs in a year. But these figures become insignificant before the performance of the common round-worm of man (*Ascaris*) which, as stated by Caullery, lays annually sixty-four millions of eggs, equal to 1,700 times the weight of its own body.

The oyster has been calculated to lay up to 60,000,000 eggs per year, though the average American yield (Lull) is considerably smaller—less than a third of this. Even on the latter basis, however, if all the progeny of one oyster survived and multiplied and so on, until there were great-great-grandchildren, their number would be 66,000,000, 000, 000, 000, 000, 000, 000, 000, 000,000, and if gourmands could be found to make away with such a feast, the heap of shells from the Olympian banquet would be eight times as large as the earth.

One of the mites or so-called " red spiders " (*Tetranychus bioculatus*) in India has been the subject of calculations by Misra, who states that the theoretically possible progeny of one female fertilised at the beginning of March might by the end of the month be 3,500,000 mites.

Coming to the insects, we find that the aphides, or plant-lice, which Erasmus Darwin compared to the " Vampire of Asia," have above all impressed observers with their



H. J Shepstone

H. J. Shepstone

DEALING WITH THE PRAIRIE DOG

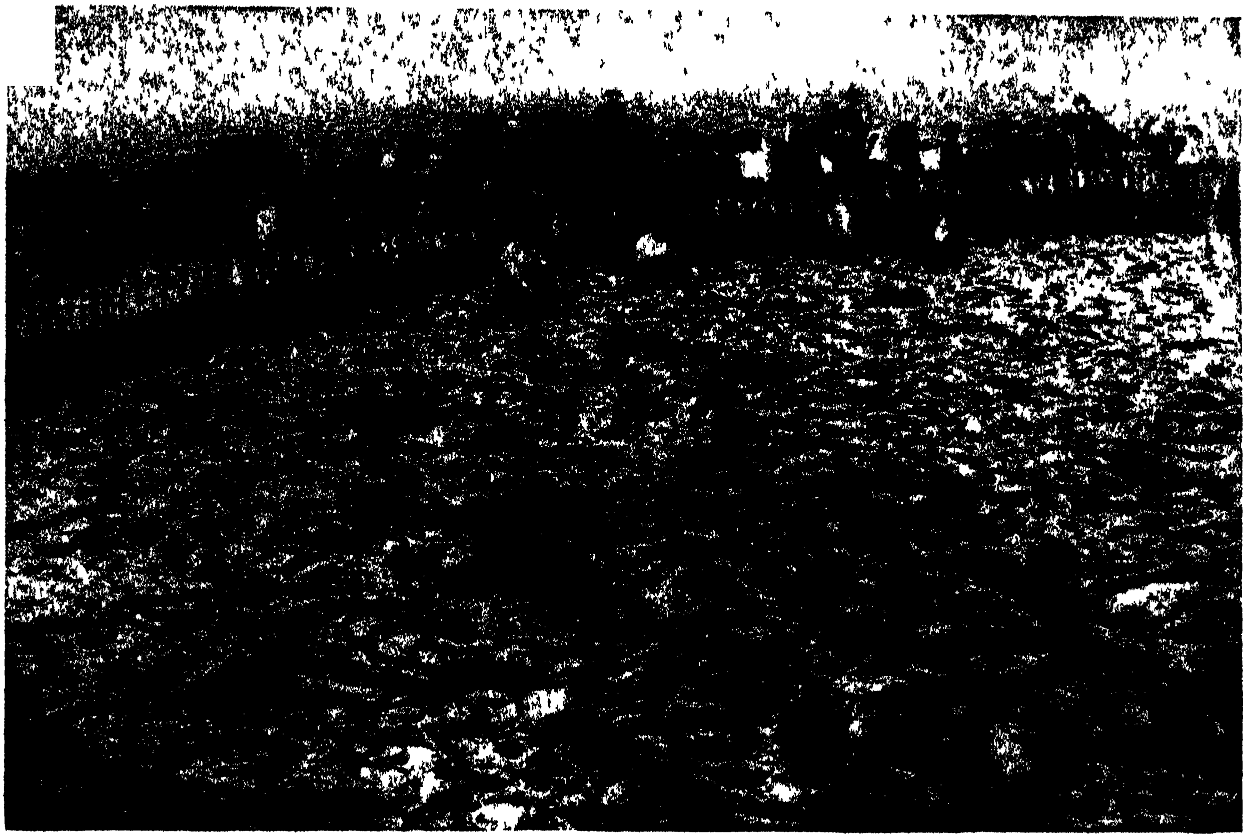
Every now and then the little prairie dogs or gophers of North America multiply more than usual. War has then to be waged on them as they are very destructive. Below is a gopher at its burrow and above a pile of 1,600 poisoned in one night in Arizona.

tremendous potential rate of increase. One of the first to calculate the possibilities—the great French naturalist, Réaumur—advanced the opinion that one parthenogenetic (that is, fertile without pairing) female aphis, if all her descendants survived and reproduced, might in one month have progeny numbering 5,904,900,000 millions.

Huxley's estimate is perhaps better known. He estimated that a single aphis, if environmental checks were removed, might produce in a year a mass of protoplasm which would outweigh all the inhabitants of China. Buckton, from his observations, believed this to be underestimated, and showed that if each aphis produced only 20 young, the progeny at the end of 300 days would number 17,000,000,000,000,000,000,000,000,000,000.

There is in Kenya Colony a distant relative of the aphides—the coffee mealy-bug (*Pseudococcus lilacinus*)—which is a very serious pest. So high is its reproductive capacity that Kirkpatrick has calculated that were it not for checks the offspring of one mealy-bug by the end of one year would weigh 40,000 millions of tons.

The vinegar-fly, *Drosophila*, was chosen as a good subject for studies in heredity, partly on account of its rapidity of increase. Maxwell Lefroy, investigating it in India, estimated that, under the most favourable conditions, a single pair of these little flies would produce in one year progeny sufficient to cover the whole of India 50,000,000 miles deep with their bodies when packed a thousand to the cubic inch.



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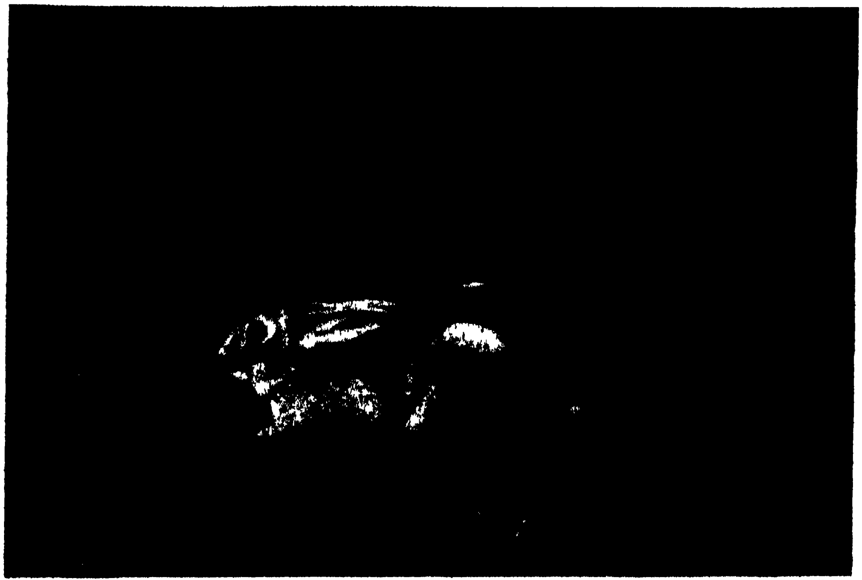


J. J. Ward

RABBIT WHOSE FECUNDITY IS A MENACE TO MAN

Rabbits may have four or even five litters in one year and the young become capable of reproducing their kind at the age of six months In ordinary conditions natural checks are present, but in Australia and New Zealand these animals are a menace In England the wild rabbit (bottom) is often a nuisance locally. Above is the result of a rabbit drive in California.

The house-fly is another rapid breeder. Lull states that the progeny of a single fertilised female without checks, would theoretically, in six generations of three weeks each, occupy a quarter of a million cubic feet, allowing 200,000 flies to the cubic foot. Howard believed that under Washington conditions, beginning on the 15th April with a single over-wintered female fly, and supposing all the offspring survived, we should have by September 10th no fewer than 5,598,720,000,000 flies.

Even the little cheese-skipper (*Piophila casei*) has a potential annual increase from one female of 240 multiplied by itself 30 times (Chapman).

The queen of one of the large African termites, or so-called " white ants " (*Termes bellicosus*), according to the observations of Smeathman and of Escherich, lays at least 30,000 eggs per day. She is reduced practically to an egg-laying machine, assiduously attended by the workers, and thus enabled to keep up this amazing output day after day and year after year, so that she may produce as many as 10 millions of eggs per year or 100 millions in her lifetime. *Termes natalensis* is said to lay only about a tenth of this total.

H. Bastin

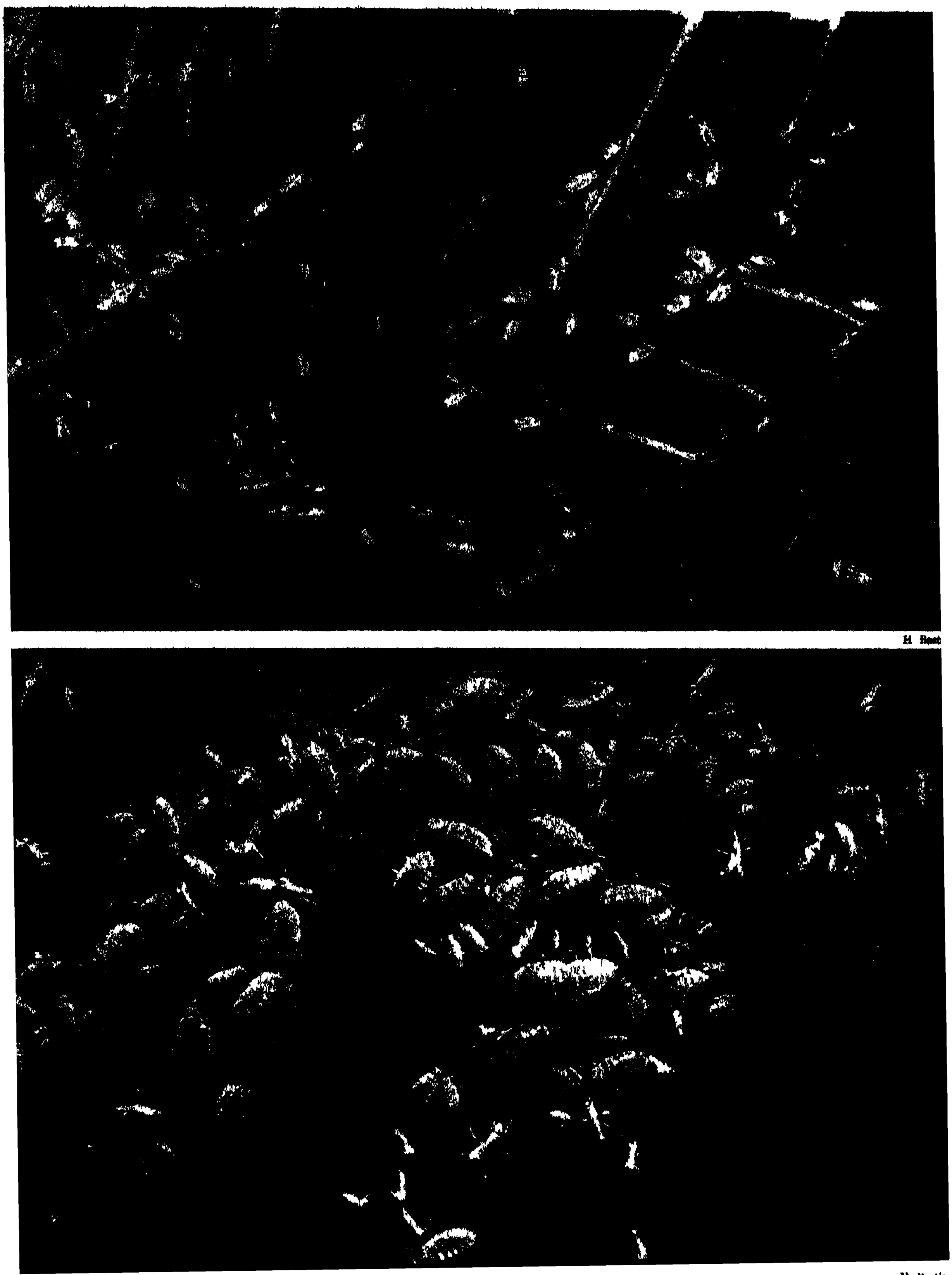
J. J. Ward

H. Bastin

H. Bastin

INSATIABLE APHIDES THAT SUCK THE LIFE JUICES OUT OF PLANTS

Aphides, or green-fly, debilitate plants by sucking their juices. As their bodies become full the excess is secreted as "honey dew" and, this falling on the skin of the plant, chokes the pores by which it breathes. Below (bottom left) is a plum leaf infected with green-fly, and (bottom right) a portion of the same photograph enlarged to show young and old green-fly swarming on the underside of the leaf. Above are (top left) leaves affected by the currant-blister aphis, and (top right) an aphis reproducing its kind by budding off young.

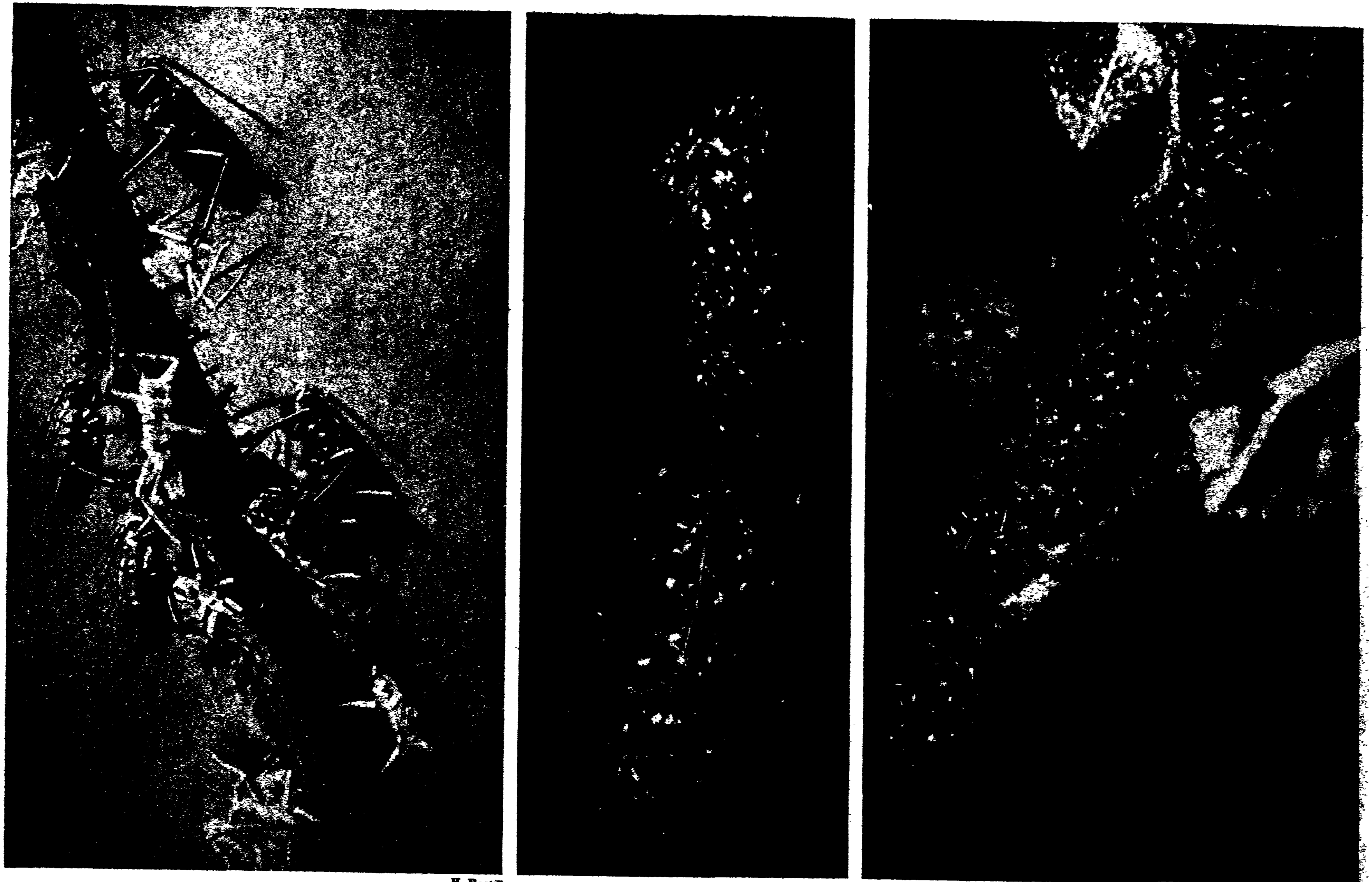


H Bast

H Bastin

MAGNIFYING LENS REVEALS COLONIES OF APHIDES BREEDING AND FEEDING

These photographs, taken with the aid of magnification, show some green-fly communities, each a little plague in itself, clustering thick on the underside of leaves where they are less conspicuous and where rain will not dislodge them. In the lower view the objects looking like white insects are really the skins of the aphides cast as the individuals grow Above are a number of newly hatched insects. So fast is the rate of reproduction, that if natural checks were temporarily weakened, green-fly might endanger human life.



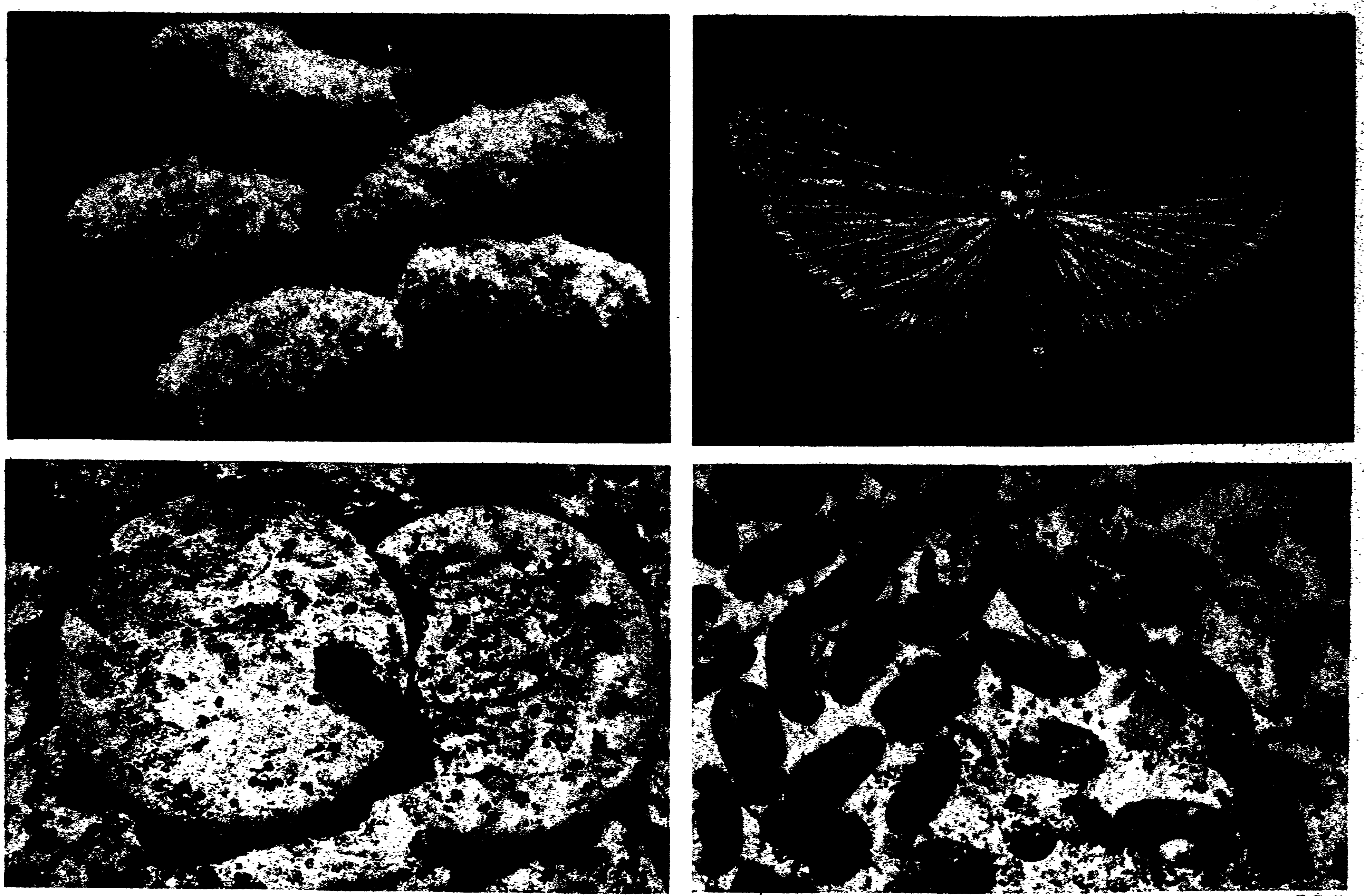
H. Bastin

H. Bastin

J. J. Ward

GREEN-FLY WHOSE PROLIFICACY IS A DANGER TO PLANT LIFE SEEN WITH THE ANTS THAT "MILK" THEM

In the left-hand illustration is a part of a raspberry cane, greatly magnified, which is infested with green-fly. Their cast skins litter the surface of the cane and it will be noticed that the hairs on the stem do not in the least prevent the green-fly from attacking it. The central photograph shows a spray of larch, natural size, which is being attacked by these voracious insects. On the right we see ants preparing to drive off to their underground nest the green-fly—which are also sometimes called ant cows because the ants suck the honey-dew secreted by them. This liquid is secreted by two tubes at the hinder end of the green-fly's abdomen. As the insect does not stop feeding when it is full the ants are able to "milk" their "cows" without injuring them.



H. Bastin

DESTROYERS OF HUMAN FOOD STUFFS: THE BREAD BEETLE AND THE MEDITERRANEAN FLOUR MOTH

"Weevilly biscuits" are a well-known nuisance on ship-board and the two lower photographs here show the results of activity on the part of the weevil *Anobium*, called the bread or paste beetle. On the left we see biscuits damaged by the borings of the grubs and on the right some sweepings consisting of biscuit dust and dead weevils. Another pest of human foodstuffs which has adapted itself to living on artificial instead of natural food is the Mediterranean flour moth (upper photograph). On the left are some cocoons made by the grubs while in the flour and coated with it. Eventually those cocoons will split and from them emerge the fully developed moth to fly away and lay eggs and then die. On the right is one of these moths considerably magnified.

E. A. Botting

J. J. Ward

POTENTIAL FERTILITY ALMOST BEYOND BELIEF

These are two views of a slipper animalcule, much enlarged. One, kept for experiment, produced in five years 3,029 generations. If every individual had survived, this would have meant a bulk of protoplasm 10,000 times the Earth's bulk.

Turning now to the beetles, we find that the grain-borer (*Rhizopertha dominica*), if Lea's figures are correct, has the following high potential rate of increase: supposing that there are five broods per season, that the sexes of the offspring are evenly distributed, and that all survive and multiply, the number of beetles at the end of the season would be 152,894,295,390.

In the case of another beetle, the rice-weevil (*Calandra oryzae*), Duvel estimated that one pair might theoretically produce in the space of six months 10,000 million pairs.

In certain small parasitic wasps the reproductive rate is tremendously increased by a peculiar phenomenon, polyembryony, in which one egg, deposited in the body of the host, gives rise to a very large number of young. Among the mammals similar cases occur regularly in the armadilloes, and certain types of twins in human beings are susceptible of the same explanation. Silvestri has especially studied the little parasitic wasp, *Litomastix*. In this insect the fertilised female produces nothing but female offspring—one egg may produce more than a thousand larvae. It thus follows that one such female, laying only forty eggs, may have no fewer than 40,000 female young which in their turn can produce as many as 1,600,000,000 offspring.

Among vertebrate animals, fishes are remarkably prolific. Lull found that in four herrings the eggs varied in number from 20,000 to 47,000. A cod may produce six millions of eggs, a turbot nine and a ling no fewer than 28 millions. Thus since ling maintain themselves at about the same numbers from year to year, the chance, as Lull remarks, of a ling's egg surviving and producing a young fish which will reach maturity is one in fourteen millions.

Compared with such figures the number of eggs laid per year by any bird is insignificant indeed. Yet Barrows has shown that a single pair of English sparrows are theoretically capable of producing in ten years, 275,716,983,698 offspring.

RABBITS, according to Lull, may have as many as six young in a litter and four litters a year; and the young begin to reproduce at the age of six months. Here again is material for the calculation of a phenomenal rate of increase. Rats and mice breed even more quickly, as man has discovered to his cost.

It is, of course, perfectly obvious that the unchecked multiplication at the theoretical rate of any of the animals just discussed would be utterly disastrous. The original realization by Malthus that such also would be the case with man led Darwin into the train of thought which culminated in the setting up of the famous hypothesis of organic evolution by means of the natural selection of favoured races in the struggle for existence. Darwin believed, and accumulated a vast body of evidence influencing others to believe, that such prodigious theoretical rates of increase coupled with the observed fact that on the average and under ordinary circumstances the population of a given species does not increase, proved the existence of a strenuous struggle for existence, a severe competition which ensured that only the most vigorous and best-adapted individuals survived to leave offspring in their turn, to inherit the accumulated favourable qualities.

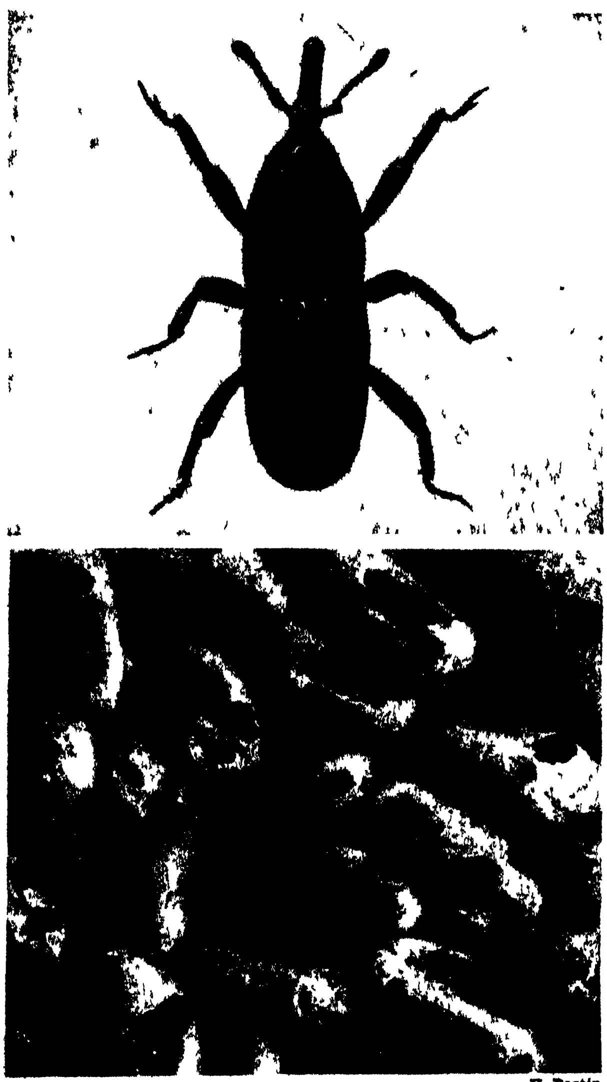
Before we pass on to examine the nature of these checks, which are the agents of natural selection, we must examine, if possible, how far the theoretical rates of increase are realized in practice if the checks are removed. This is naturally a difficult problem, but Graham-Smith (1916) has tackled it in the case of flies. This very careful observer allowed blow-flies to lay eggs on dead rabbits in a large open-air net cage. The flies which emerged and their descendants were thus protected from natural enemies and very largely from other adverse conditions, and they were supplied with abundant food. The results may be summarised in the author's own words: "According to Fabre the blow-fly lays about three hundred eggs in one batch and therefore the first generation resulting from a hundred parent females ought to have consisted, had adults matured from all the eggs deposited, of at least 30,000 individuals. The total number, which emerged under apparently favourable conditions, was 2,789." The final result of the experiment was that "The descendants of the hundred females, which emerged from winter pupae, numbered during the season about 13,000 adults, instead of the 101,250,000,000 postulated in four generations by the calculation employed by Howard, or to put the matter in figures which can be more readily understood, the descendants of each female during the season numbered 130 instead of 1,012 millions." While it is difficult to be sure that all adverse circumstances had been obviated, the discrepancy here between actual and theoretical results is so very great that it is obvious the latter are exaggerated, and that there exist intrinsic factors which limit increase much below the possibilities calculated on the number of eggs.

Further light has been thrown on this question by the researches of Thompson and Parker on the corn-borer (*Pyrausta nubialis*), a moth-caterpillar tunnelling the stalks of maize. These writers distinguish as intrinsic controlling factors "those characteristics of structure and habit peculiar to the species, by reason of which a high mortality occurs in certain phases of existence, even in the normal environment." Such factors limit the increase of the corn-borer more than any other single group of adverse outer influences. Apart altogether from environmental checks "Only a very small fraction of the population represented by the eggs actually reaches maturity."

Let us then freely admit that estimates of potential increase based on the number of offspring may be exaggerated and misleading. It still remains true that without external checks almost any animal species would increase beyond all bounds. This holds true even of animals with an extremely low rate of increase. Thus the fulmar petrel lays only one egg; yet it is believed to be the most numerous bird in the world (Darwin). In fact, so far as actual increase is concerned, other factors may be much more important than mere fecundity.

In fishes, like those instanced above, the spawn is deposited more or less at random and a stupendous number of eggs is necessary to ensure that one or two young per parent may survive. In the case of internal parasites like the tape-worm the voided eggs must be swallowed by an intermediate host, and its flesh in turn devoured by the final host. The chances against success are here so great that an even more phenomenal number of eggs must be produced. But in those insects which deposit their eggs actually in the midst of an abounding food-supply; in birds which shelter their eggs in a nest and feed the newly-hatched young; and above all in the mammals (including man) which suckle their offspring and tend them carefully until they can fend for themselves—in all these higher organisms the need for such extreme fecundity is gone, and the population is maintained by means of a higher survival rate among the much fewer young.

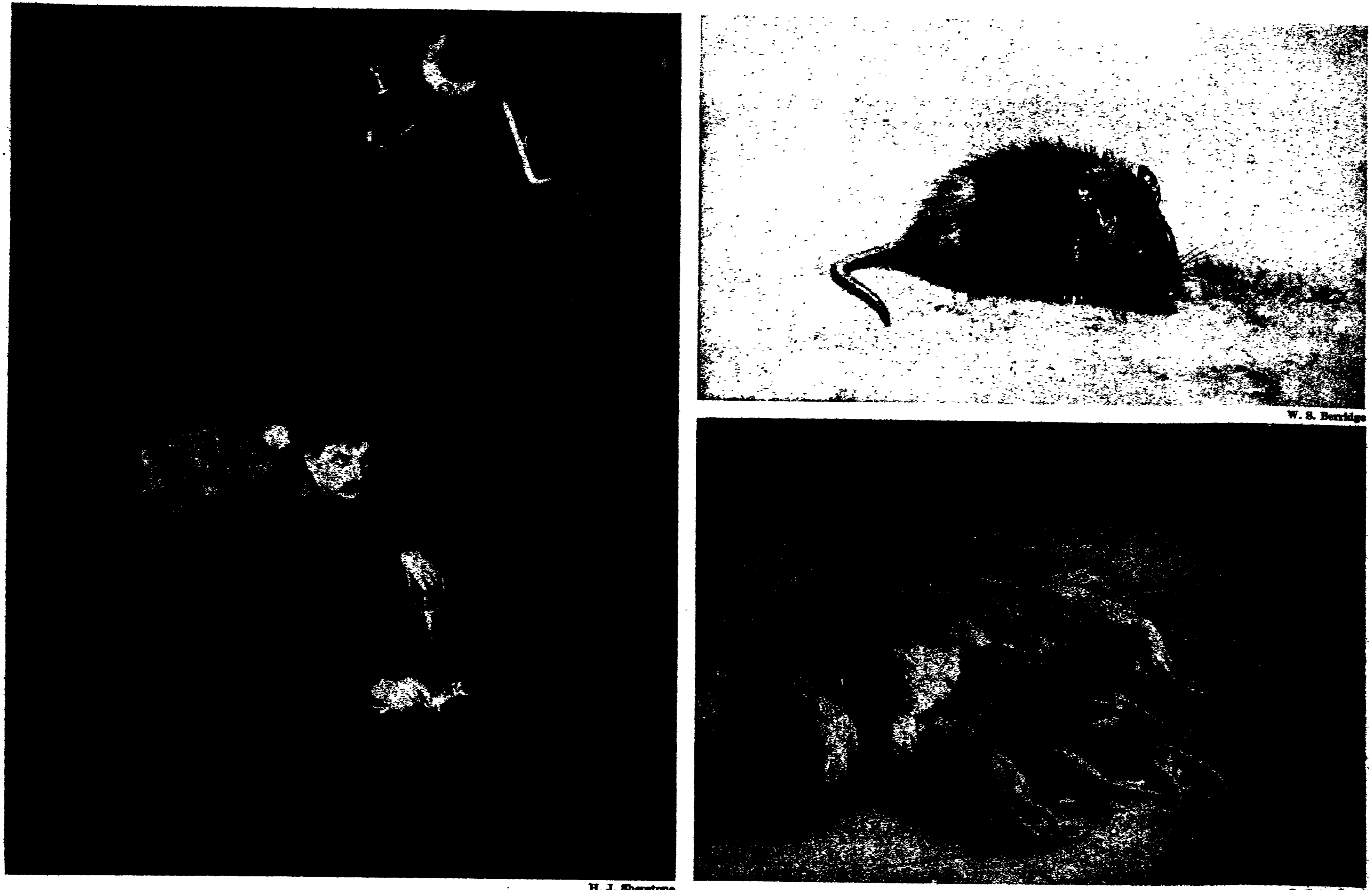
There is, then, a very definite check on the increase of all animals, ensuring that their populations ordinarily remain stable. Thus Cooke found in the north central United States that there were about eleven nesting pairs of English sparrows to every hundred acres of land. During a five-year period, when an accurate census was made, this number fluctuated only from nine to thirteen. Yet, adopting the rate of increase cited in our first section, we should expect each hundred acres of land to give rise to 575 sparrows every year; but the number remained constant. Since we know of no intrinsic limiting factors in this case, we may agree with Chapman that "This difference between the potential number of sparrows and



H Bastin

GRAIN WEEVIL AND ITS WORK

Grain weevils have a very dangerously high rate of reproduction. From one rice weevil, for instance, there could be produced, at any rate in theory, 10,000 million pairs in six months. Here we have the grain weevil (top) and its work (bottom.)



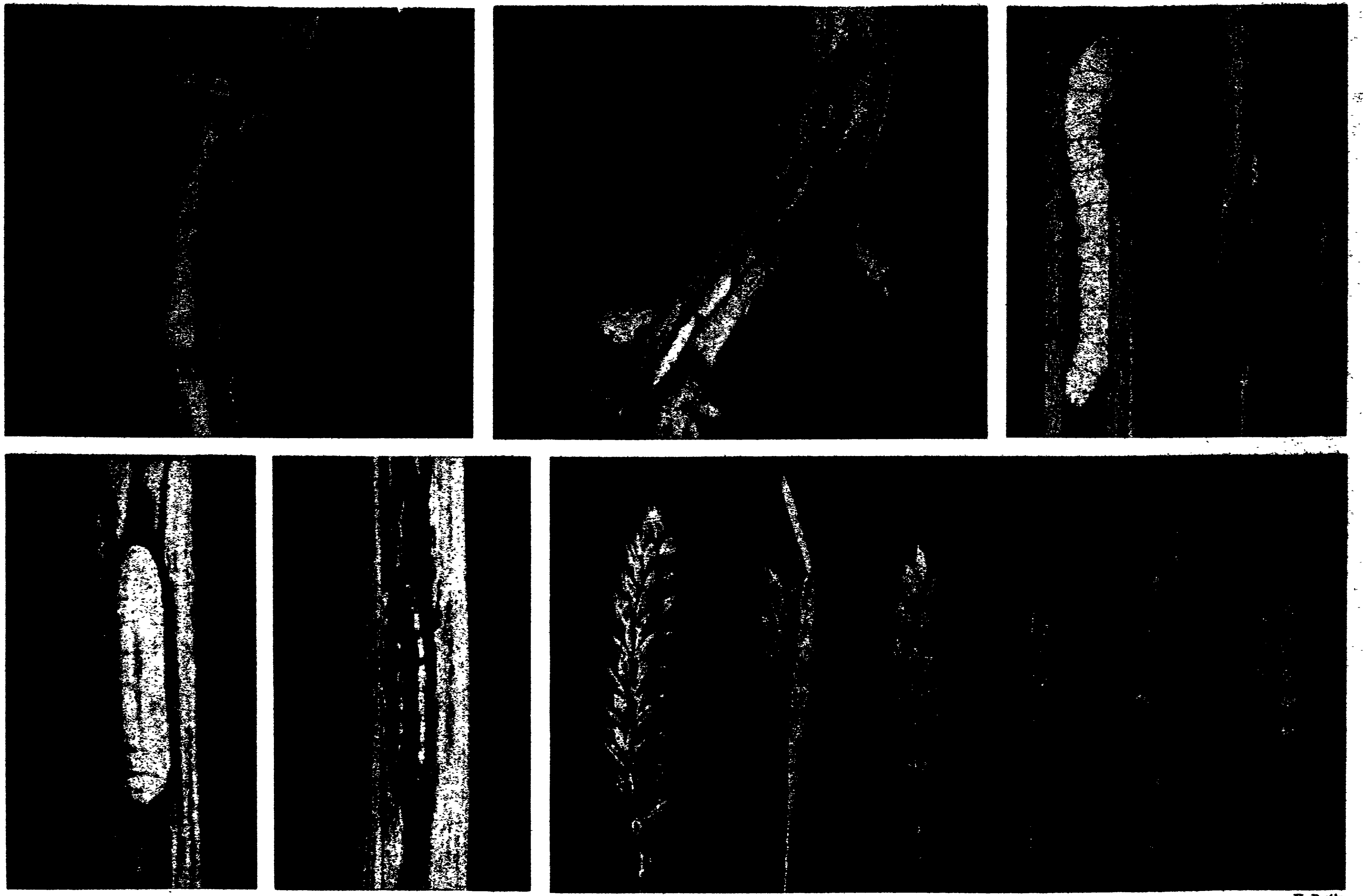
H. J. Shepstone

W. S. Berridge

J. T. Newman

NUISANCES TO HUMANITY: RATS THAT BREED AT AN ALARMING RATE AND ONE CAUGHT IN A PARIS SEWER

Rats can increase under conditions favourable to them in an alarming way as man has found to his cost. Being very versatile—they are virtually omnivorous, can board ships and get transported from one end of the Earth to the other and can adapt themselves quickly to great changes of conditions—their tenacity of life is great. Sewers are proverbial haunts of the rat and there are many stories of the "sewer rats." There is, of course, no special sub-division of the rat family which lives habitually in sewers and the numbers of those that do are often exaggerated. About forty or fifty drowned rats are found every day on the grids at Barking Outfall which serves the whole of London north of the Thames. On the right are (bottom) a brown rat and (top) a black rat.



H. Bastin

CORNSTALKS THAT ARE ATTACKED BY QUICK BREEDING ENEMIES, INCLUDING THE CORNFLY AND SAWFLY

Of these photographs, which are mostly of magnified subjects, the lower row shows the destructive work of the goat, or ribbon-footed cornfly. On the left is a cornfly larva just before pupating. In the centre photograph is the pupa safely ensconced in a groove cut in a wheat stalk. The right-hand illustration is of half a dozen ears of corn. On the left is a normal ear, then, moving to the right, specimens damaged by the cornfly, Hessian fly, wheat midge and sparrows. The upper row of photographs is of the corn sawfly and shows, from left to right, how the larva cuts out the inside of the cornstalk just before pupating; the attacked stalk opened to show the cocoon at its base; a larva in the stem and, beside it, a stem showing how the joint has been bored through.

H Bastin

INTENSIVELY MULTIPLYING CHEESE SKIPPER

The cheese skipper is a fly (bottom left) that lays its eggs on cheeses whose larvae (top) bore their way within and feed until they are ready to become pupae (bottom right) The potential increase from one female is 240 to the power of thirty, annually

the actual number must be a measure of the toll taken by the environment "

It has remained for man, in certain circumstances, to give to a number of animal species the opportunity of realizing more nearly their potential rates of increase As Darwin first suggested, a very striking example of rapid multiplication in the absence of many of the customary checks is afforded by the progress of animals and plants introduced intentionally or accidentally into new countries Thus the horse, imported into America by the Spaniards, very rapidly spread through a great part of the New World , the prickly pear introduced into Australia speedily covered and rendered agriculturally useless a huge area which is now increasing at the rate of one million acres per year , rabbits first introduced into New Zealand some time previous to 1838, were already in 1866 referred to as " That great scourge to our large run-holders " At the present day " The economic waste caused by the vast increase of rabbits in New Zealand is incalculable, and certainly represents a loss in the stock-carrying capacity of the country which probably runs every year into millions of pounds " (Thomson, 1922). The sugar cane leafhopper (*Perkinsiella saccharicida*) was accidentally introduced into the Hawaiian Islands about 1897. By 1902 it had increased to such an extent that sugar production on one infested plantation fell in three years from 19,000 to 7,000 tons.

There are other means also by which man inadvertently renders conditions favourable to animal increase. He does this especially by increasing their food-supply. Agriculture consists in nothing more nor less than a systematic attempt to favour, over large areas, the growth of certain limited species of plants to the detriment of their natural competitors, which automatically become weeds. Animals feeding upon these cultivated plants are commensurately encouraged. The balance of Nature is disturbed. A striking instance occurred in Australia during the War, when unparalleled stocks of wheat were accumulated. At one port alone, in three yards, five million bags were stacked. This led to a plague of rats and mice, which was succeeded by one of weevils (*Calandra*) At certain times the latter swarmed from the stacks and piled up four or five inches deep on the ground. " In Wallaroo yard alone, when the plague was at its worst, up to one ton of weevils per day were gathered up and destroyed."

How is man with his industries to fare in this welter of proliferation ? He is now endeavouring, in one of the most interesting biological experiments of the present century, to tackle the problem fundamentally. Where a destructive animal has been introduced into a new country and its natural enemies are lacking, he imports enemies from the original home.

J. J. Ward

HARMFUL MITE CALLED " RED SPIDER "

According to careful calculations the progeny possible to one of the Indian mites, called " red spiders," might be 3,500,000 mites from one female in four weeks. Natural causes reduce its numbers, but this mite does great damage to crops.

Chapter CXIV

The Wonder of Mother Love Among the Animals

By Frances Pitt

Author of "Woodland Creatures"

Mother love among birds and beasts is a marvellous force, driving the most timid creatures to desperate deeds for the sake of home and young. I have known of a mother rabbit turning upon a stoat in defence of her family; and I have seen a tiny merlin attack a great raven because the latter came too near her nest.

It was in the Shetland Islands that I saw the latter episode. The merlin had a nest on the hillside, or rather had taken possession of an old hooded crow's nest, and had therein five greyish-white eyasses, the quaintest most witch-like little birds, that looked out from their home on the hillside over the wide heathery expanse of moor and island. The two old merlins watched over their family with greatest care. Let anything strange appear, even in the distance, and the keen-eyed cock saw it instantly, giving warning to his mate with a chattering call. She was, after the manner of hawks, bigger and stronger than he, but still she was only a small bird, no larger, in fact, than a mistle-thrush, yet she was a marvel of pluck and determination.

One day when I was lying among the heather on the hilltop, watching the wild life of this barren, wind-swept spot, I saw a great black raven flapping over. The ominous bird came onwards on his sable pinions, flying slowly and majestically, until almost over the merlin's nest, when out from her eyrie shot the little hawk. Straight as an arrow she came, driving at the raven with utmost determination. Beside his black majesty she looked no bigger than a sparrow, and in real fact she was little larger than a thrush; yet she went at the raven with indomitable resolution—she was not going to allow any black robber near her young family.

Again and again that merlin flew at the raven, getting above him and diving down, when he turned and twisted and tried to elude her, flapping his great wings and making off as fast as he could go. The plucky little mother had fairly put the intruder to flight, he swerved before her attacks, and flew off faster than ever; but she was not satisfied. She followed him up, and pursued him far across the valley, until she was almost lost to sight, and the raven was but a speck in the distance.

At last the merlin was satisfied, left her quarry, turned about and came home, gliding up in the beautiful, effortless flight of this hawk, to close her wings and alight on a rock near the nest. Here she sat and rested. I watched her preening her ruffled feathers and putting her apparel to rights, but all the while she was on the look out, and her dark eyes took in everything that stirred. When at last I moved from my hiding-place she was instantly upon the wing, following me across the moor, and chattering angrily the while. But even she drew the line at attacking a person.

Yet there are some birds that have the pluck to do this, and one of them is that dark-coloured robber gull, known as the great skua. The great skua haunts the northern seas, where it gives other gulls an unhappy time, harrying and hunting them for the fish they have caught. In the spring-time it resorts to wild and wind-swept islands, where it lays its dark eggs, and hatches two olive-coloured chicks. For those quaint roly-poly babies it will dare a very great deal. I well remember helping a friend who wished to take snapshots of some skua chicks, and what a lively time the old birds gave us. They dashed towards us, darting over our heads with a mighty rush of wings, and at last, as my friend was stooping over her camera, one skua, shrieking "sku-arr, sku-arr!" as it came, dived headlong at her, and hit the side of her face with its webbed feet. It was a real smack. My friend had a sore face for days after.

Another courageous bird is the homely brown or tawny owl, that fluffy, comfortable bird that is so common in woodlands throughout Europe. An old owl will venture much in defence of her owlets, as when I was stooping over a hole in a hollow tree, trying to inspect the owl family at the bottom of it, and received a resounding smack in the middle of the back. Not having seen or heard anything I jumped up much startled, but not a thing was to be seen. Still mystified, I turned to have a second look at the owlets, when bang, something gave me another thump, I sprang around in time to see a large owl gliding off. Of course, with its downy, muffled wings it had been able to attack suddenly and unheard. I retreated, feeling very respectful towards the irate and formidable mother.

Indeed, she deserved respect, for many birds, bigger, stronger and better armed, would not have displayed the mother love that she did. Even the magnificent golden eagle in its mountain eyrie might not have attacked an intruder, nor would many another large and fierce-looking bird of prey.

We find, however, some brave mothers among the four-legged beasts, no mammal being more courageous in defence of its young than the cat, and the homely, everyday cat at that. Puss is indeed a wonderful study in mother love; watch the devoted care with which she tends her kittens, licking and dressing them, cuddling them to her furry flank, and, as they

Neville Kingston

W. S. Berridge

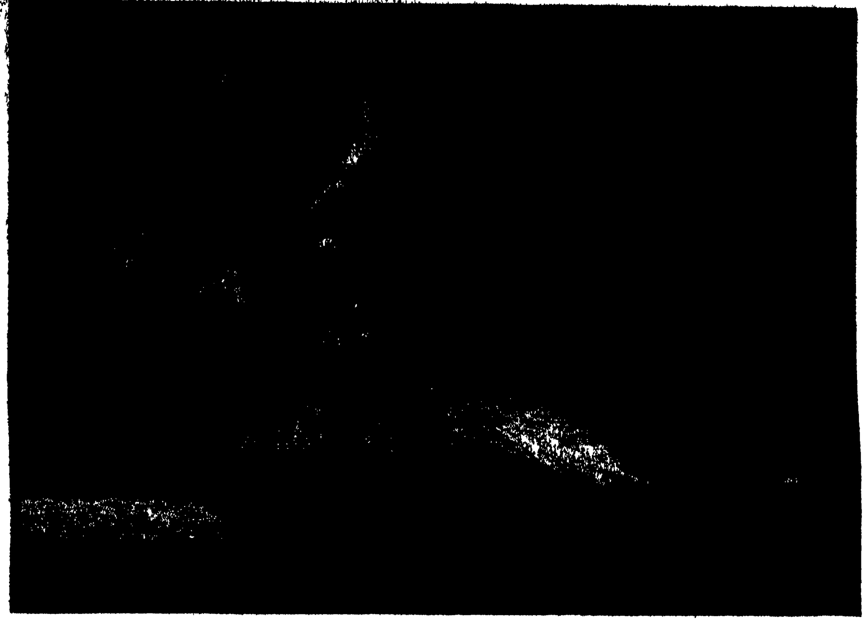
MOTHER LOVE AS EXHIBITED AMONG THE MONKEYS: FOSTER PARENT AND REAL PARENT

Since this South-American monkey (left) had no young one of its own it adopted a marmozet. The instinct to mother something was too strong to be denied and had to find an outlet. Humouring the more delicate feelings of the animals is one of the tasks that those who look after modern zoos set themselves, thereby finding their captives happier and healthier animals. Our right-hand photograph shows a pig-tailed macaque. It is up against the wire netting of its cage with its young. Some monkeys, when they have young ones, become very suspicious of visitors: but they usually find that more than the ordinary share of good things is theirs for the sake of the very maternity which has made them withdraw from the bars.

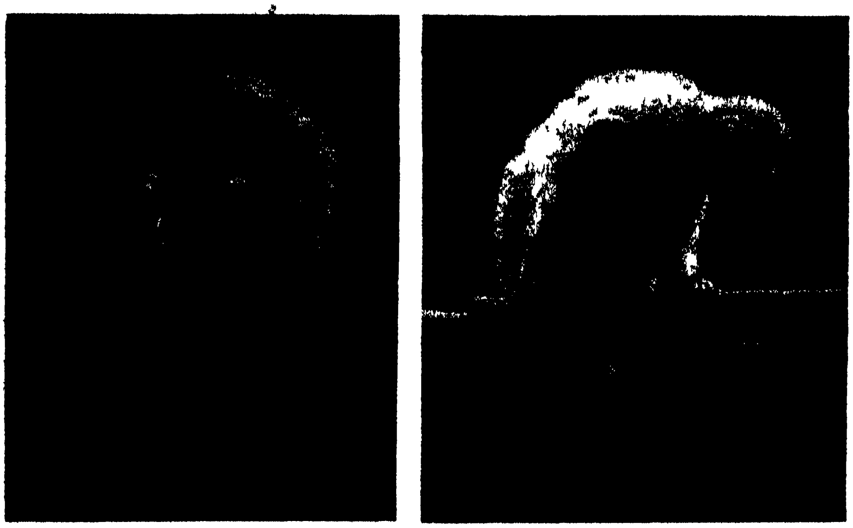
get older suffering their teasing, when they pull her tail and bite her ears in their playful glee in life; but, when any danger threatens, what a change! Is there a greater fury than an angry cat with kittens to defend? Brave, or rather very foolish, is the dog that would venture near that family. With no thought of danger, utterly regardless of self, the mother flies at the intruder, using her claws with such fiery wrath that hardly any dog can withstand her onslaught.

If this fury animates our household puss when danger, fancied or real, threatens her kittens, what of the true wild cats, whether it be one of the wild cats that are found in the mountains of Scotland and other parts of Europe, or the different wild cats found in various parts of the globe? Most of them are among the bravest of mothers, ready to dare and do anything for their little ones, rushing upon what seems like certain death if their babies appear imperilled.

In saying this, I am speaking of the smaller cats, for courage in the cat tribe does not seem to increase with size. Of course a tigress or lioness with cubs to defend is a dangerous beast, not to say a very dangerous one, but if its courage was as proportionately great as that of our little house puss, well, it would win in every contest and dominate the jungle.



W. S. Berridge



H. Bastin

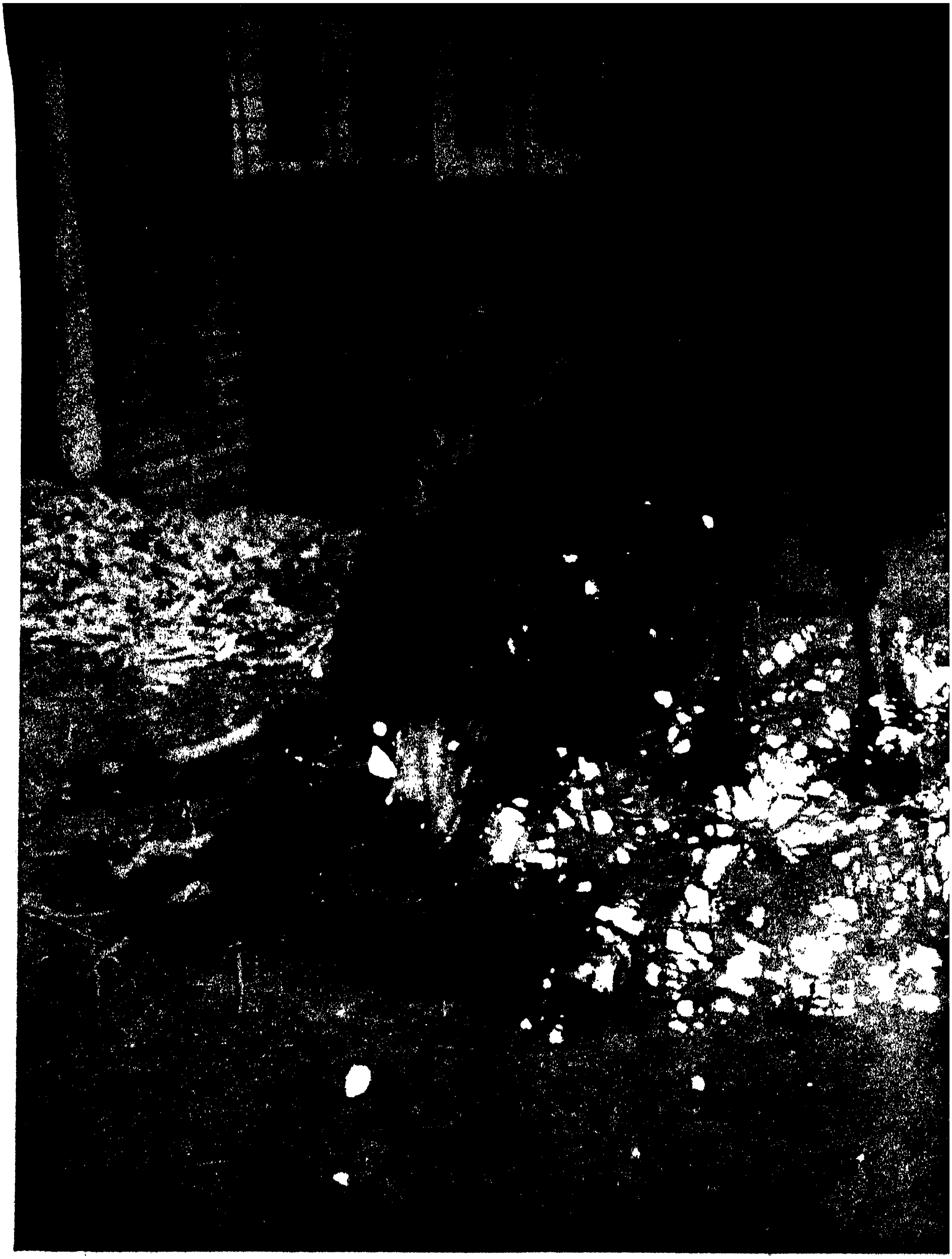
CAPPED LANGURS AT THE LONDON ZOO

These very interesting studies of female capped langurs and their young come from the London Zoo, where the photographs were taken. Below, on the left, the mother is crouching on a perch and stooping attentively over the young one, which is held between the knees In the next photograph (bottom right) the attention is wandering. But, above, the nine-days-old baby is being held firmly to the breast by its mother.

Some of the smaller, badly-armed, and almost defenceless creatures are really the bravest where their young are concerned. The ordinary sheep of our meadows, usually spoken of as the "silly sheep," is not such a fool that it will not try to defend its lambs, and put up a quite effectual defence too. The ewe who has hitherto galloped in panic when the sheep dog yapped at her heels, now stands her ground, threatens the dog with lowered head, and even gives him a thump in the ribs. Mother love, welling within her, nerves her to a bravery she has never known before.

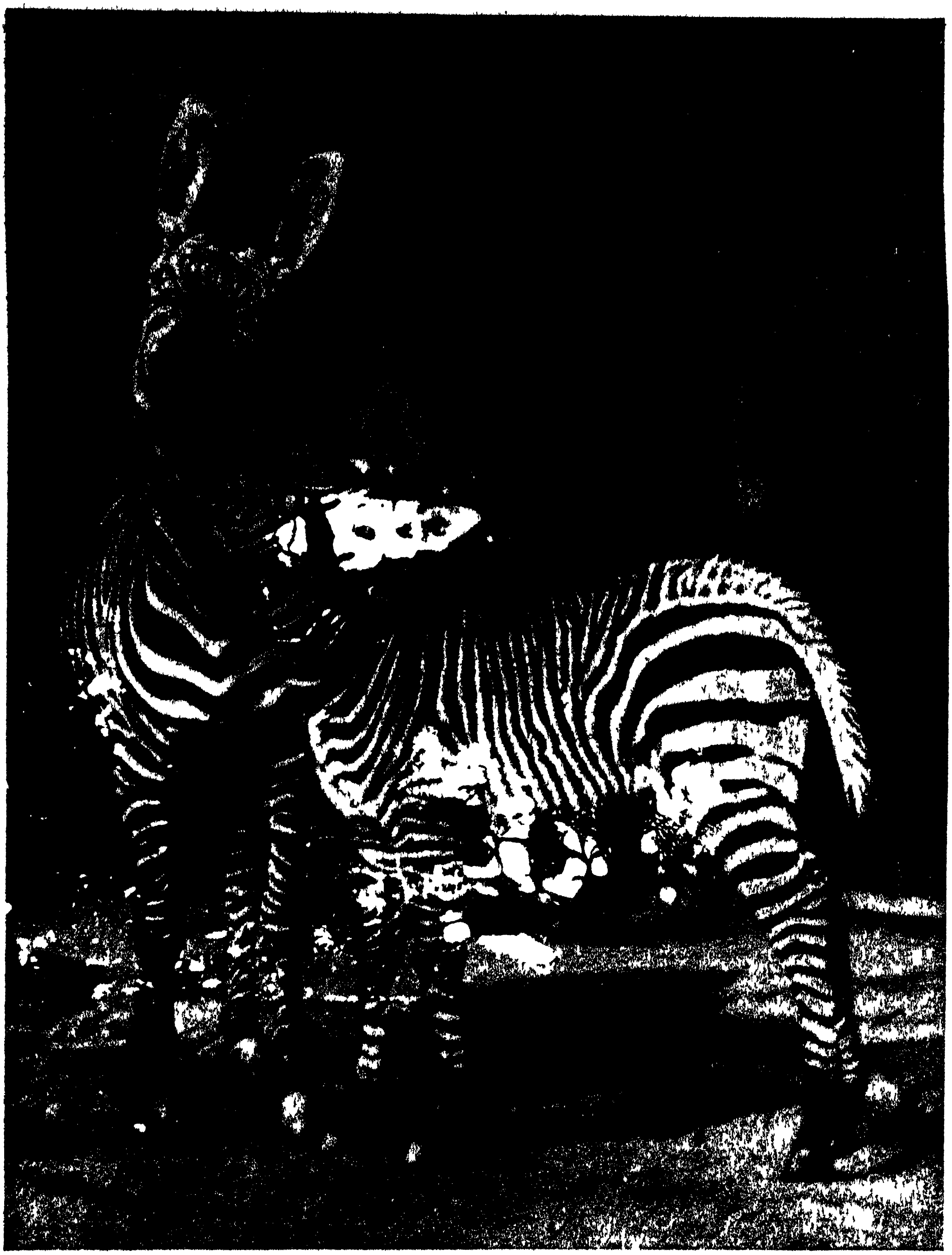
Perhaps one of the bravest performances in defence of the young is that commonly spoken of as the " broken-wing trick," which certain birds go through in an endeavour to lure a foe away from their offspring. I have seen many different species of birds do the trick, Arctic skuas when their nesting colony on a wind-swept island moor was invaded, partridges in an English meadow, a pintail duck on a bog in the Scandinavian mountains, golden plover on a Shetland hillside, and so on.

The pintail duck did the trick particularly well. I had seen her on this part of the bog before, and was searching the marshy ground, wading backwards and forwards across its uncertain surface, peeping and peering into the tussocks, in the hope of finding her nest, when the duck flew up, or rather floundered



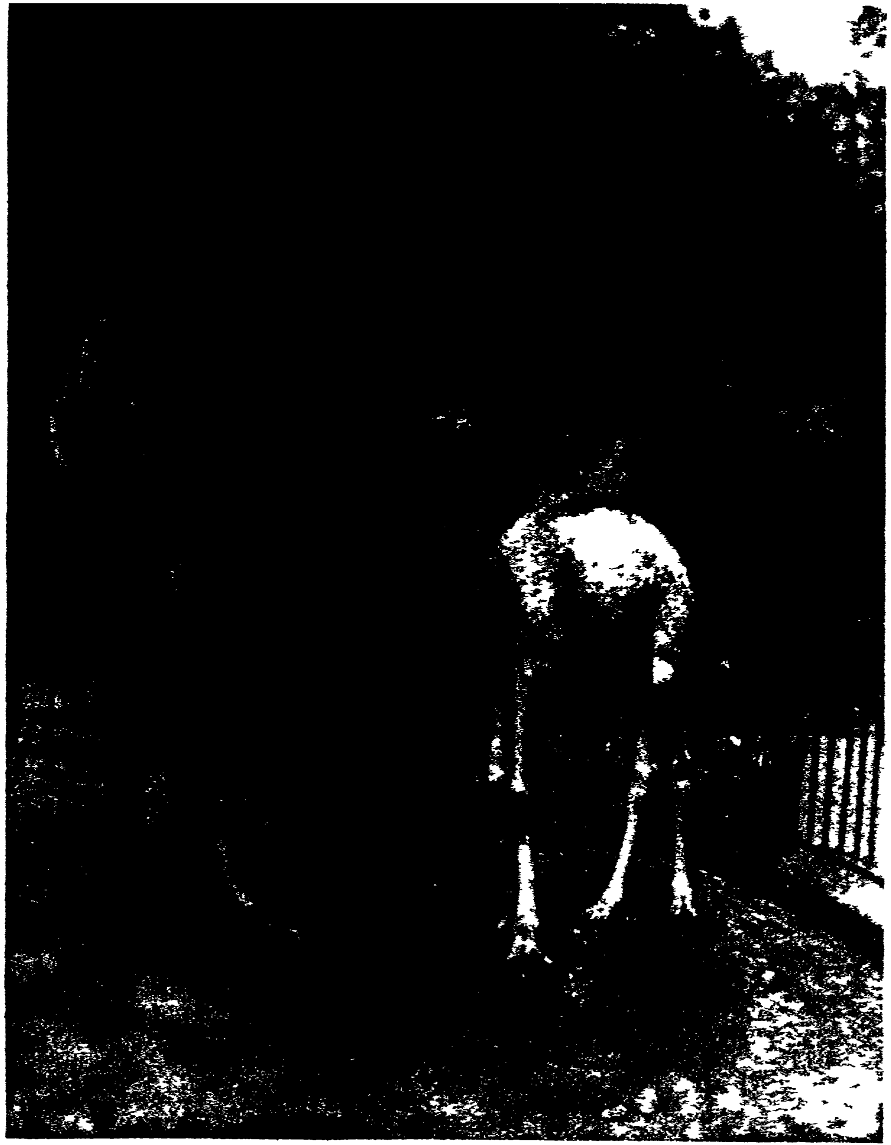
FIRST BABY CAMEL TO BE BORN AT THE LONDON ZOO FOR SEVENTEEN YEARS

Assiduously licking her young one, this animal gives us a sight of mother love as practised by that most unaffectionate of domestic beasts, the camel. It is always something of a triumph when certain of the wild animals are induced to breed in captivity, and it seems the more surprising that a domesticated animal like the camel should so seldom bear young at the London Zoological Gardens. Yet this is so, for the infant camel seen here was the first born at " the Zoo " for seventeen long years.

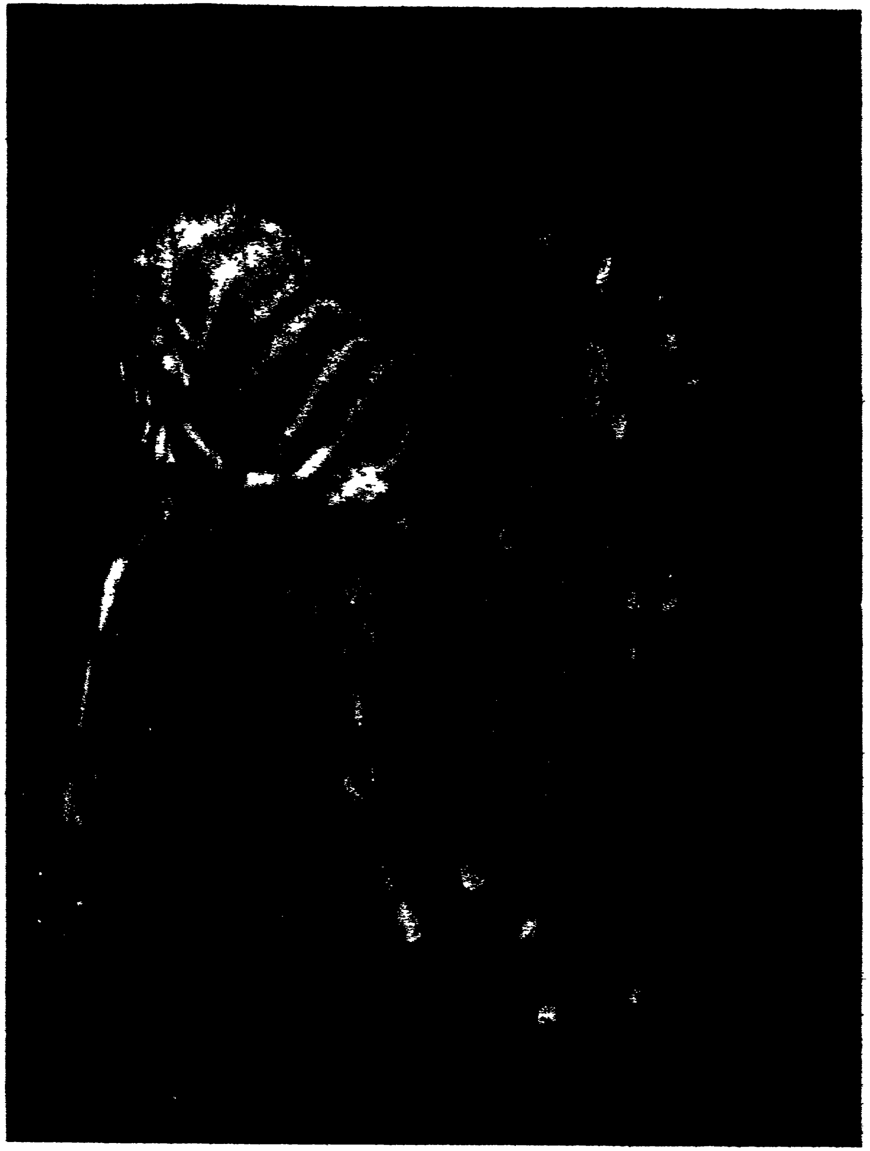


YOUNG ZEBRA COLT GIVES ITS MOTHER AN AFFECTIONATE LICK

Among animals the first and the most constant association between mother and offspring is licking This cleansing action is also soothing to the new born and nervous animal, and takes the place of the caress of a human mother to her baby Naturally enough this young zebra pays its mother back in her own kindly coin. Perhaps when the effects of a few maternal bites have been felt, there may be more reciprocation but of a less charming kind. But animal mothers are usually very patient.



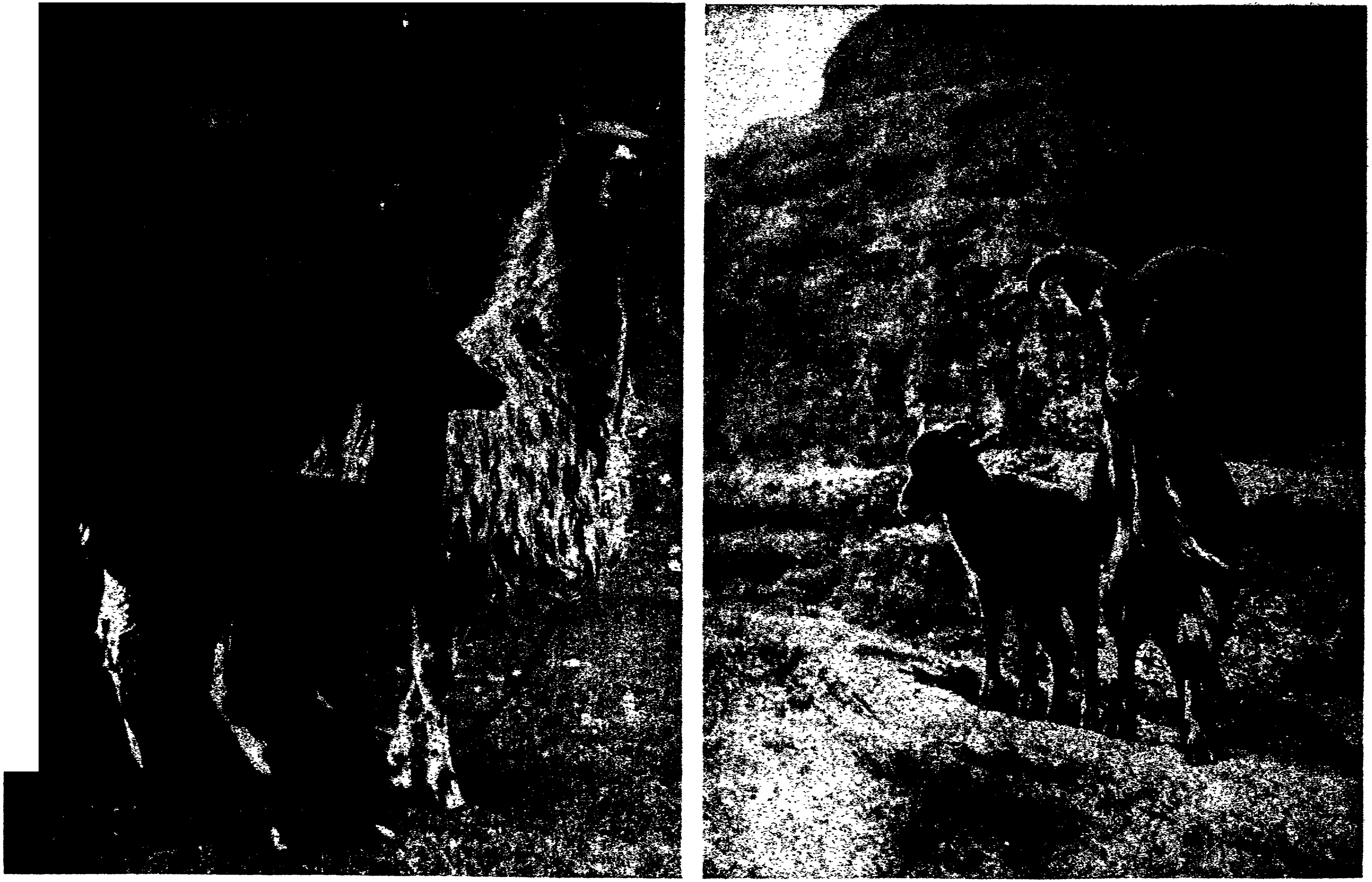
W. S. Berridge



W. S. Berridge

ARABIAN CAMEL WITH ITS DELICATE CALF: CONGO MARSHBUCK AND ITS LATEST BORN

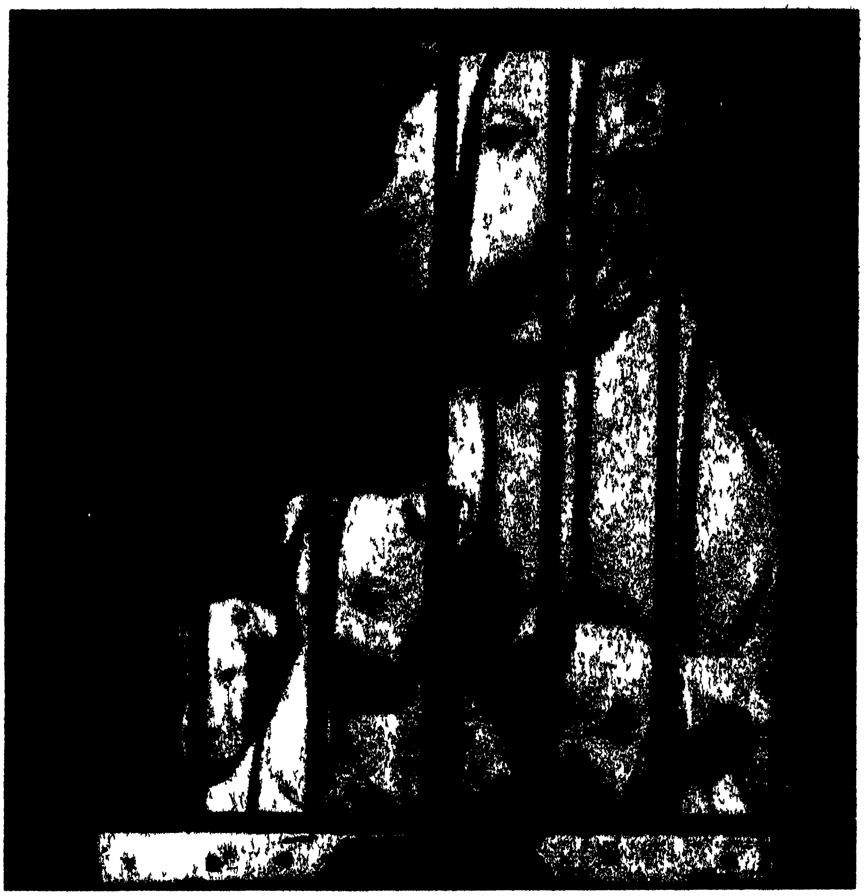
Arabian camels have one calf at a birth, and it runs with its mother and suckles for a year or even more. Very young camels are rather helpless creatures, and when large camel herds are kept as they are for instance in the Sudan, the young ones are often slung by a net to the back or side of full-grown animals when the herds are driven northward in the rainy season. The mothers are very fierce and defend their offspring with their teeth—the camel's most dangerous weapon Our right-hand photograph shows a Congo marshbuck with its little one just two days old. The legs of the calf are not so very much shorter than the mother's but its body is only about a quarter the size. The legs have to develop quickly so that mother and offspring may keep together.

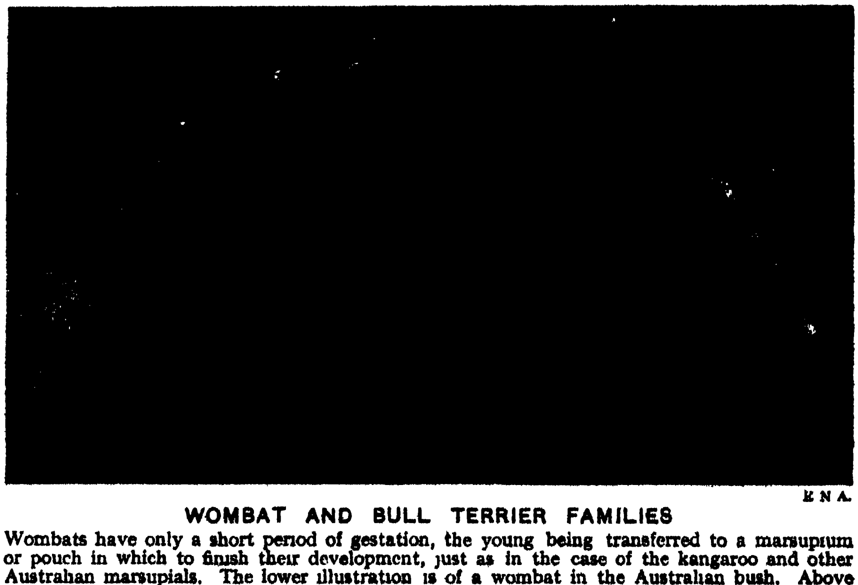


Neville Kingston

FEMALES OF THE LLAMAS AND BARBARY SHEEP THAT BOTH MAKE GOOD MOTHERS

Llama mothers apparently have an arduous life with the young, for it is said that they are not unusually suckling two generations at the same time. However, only one offspring is born at a time, in the ordinary way, so that the strain of the length of time before weaning is partly compensated for by the small size of the family requiring nourishment. It is to be noticed in the left-hand picture that the young llama is dark all over, while the mother has the foreparts, legs and neck, white. Young Barbary sheep (right) need most tender care, for they are brought up in the wildest and most inhospitable parts of the North African uplands. But the parents, like all wild sheep, will defend their offspring very courageously.





E N A.

WOMBAT AND BULL TERRIER FAMILIES

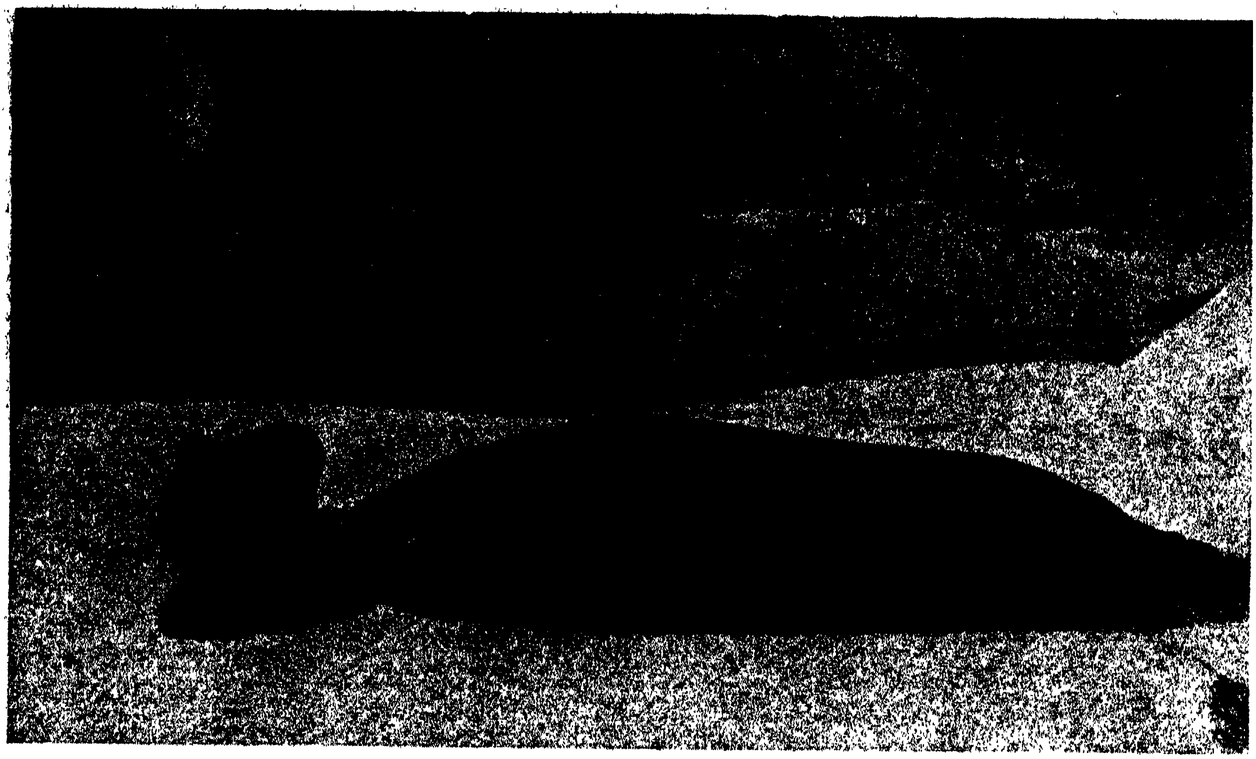
Wombats have only a short period of gestation, the young being transferred to a marsupium or pouch in which to finish their development, just as in the case of the kangaroo and other Australian marsupials. The lower illustration is of a wombat in the Australian bush. Above is a much more familiar kind of mother, a bull terrier with her litter.

up at my very feet. I had almost stepped on her and her ducklings There they lay, flat on the peaty soil, such quaint, rather sandy-hued youngsters, with that snaky aspect which is characteristic of the adult pintail However, I barely glanced at the ducklings for the old duck took my attention. She was floundering on the bog like a creature sorely wounded, flapping about as if almost helpless. Her actions were not so much those of a bird with a broken wing, as of one with all limbs broken I am sure a dog, fox or cat would have been completely deceived by the way she "carried on."

I stood quite still while she floundered and tumbled off across the marsh, but when she found I was not following her she came back and again tried to lure me away. This time I walked after her, while she tumbled ahead, with frantic quacks and much flapping. Of course, she led me away from the ducklings, but the further we went the quicker became her actions, until she was half-running, half-flying across the watery ground. Finally she spread her wings, rising with what sounded like a derisive quack, and flew off towards a little stream. I turned about and walked back towards the ducklings which brought the pintail duck after me. She flew from the stream, alighted near, and began to tumble about again.

Thinking it might be possible to get a photograph of her performance, I ran back to the house to fetch a camera, being away less than twenty minutes. On returning I went straight to the spot where I had left the little ducklings hiding, but they had gone. Their devoted mother had got them away. In vain did I search up and down the bog, not a trace of those ducklings could I find. The old duck flew up, but made no attempt to do the broken-wing trick. Did she know that she had defeated me, and had hidden her family where I could not discover them? It looked like it. But what love and devotion had inspired her previous actions!

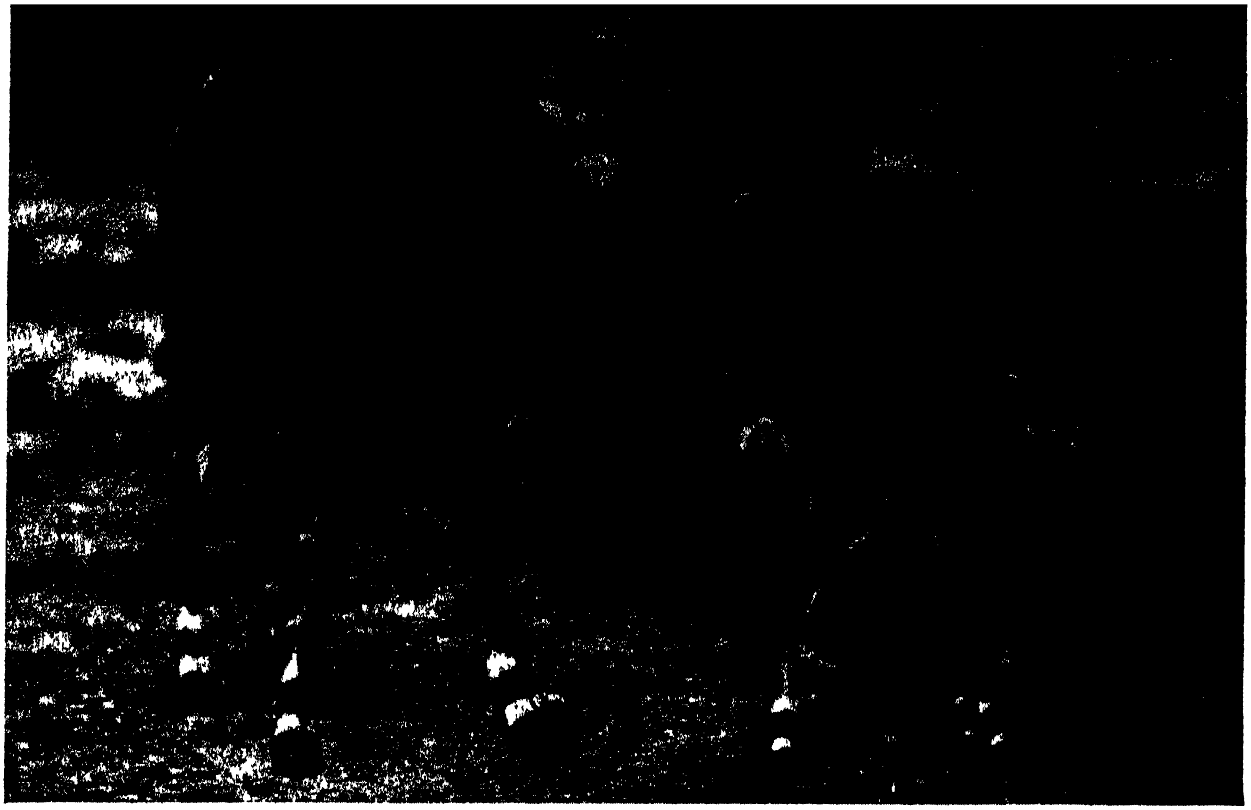
It is an interesting question how far such a performance is instinctive and how far intelligent. Is it the result of unreasoning impulse arising from fear combined with love for the little ones, or is it a



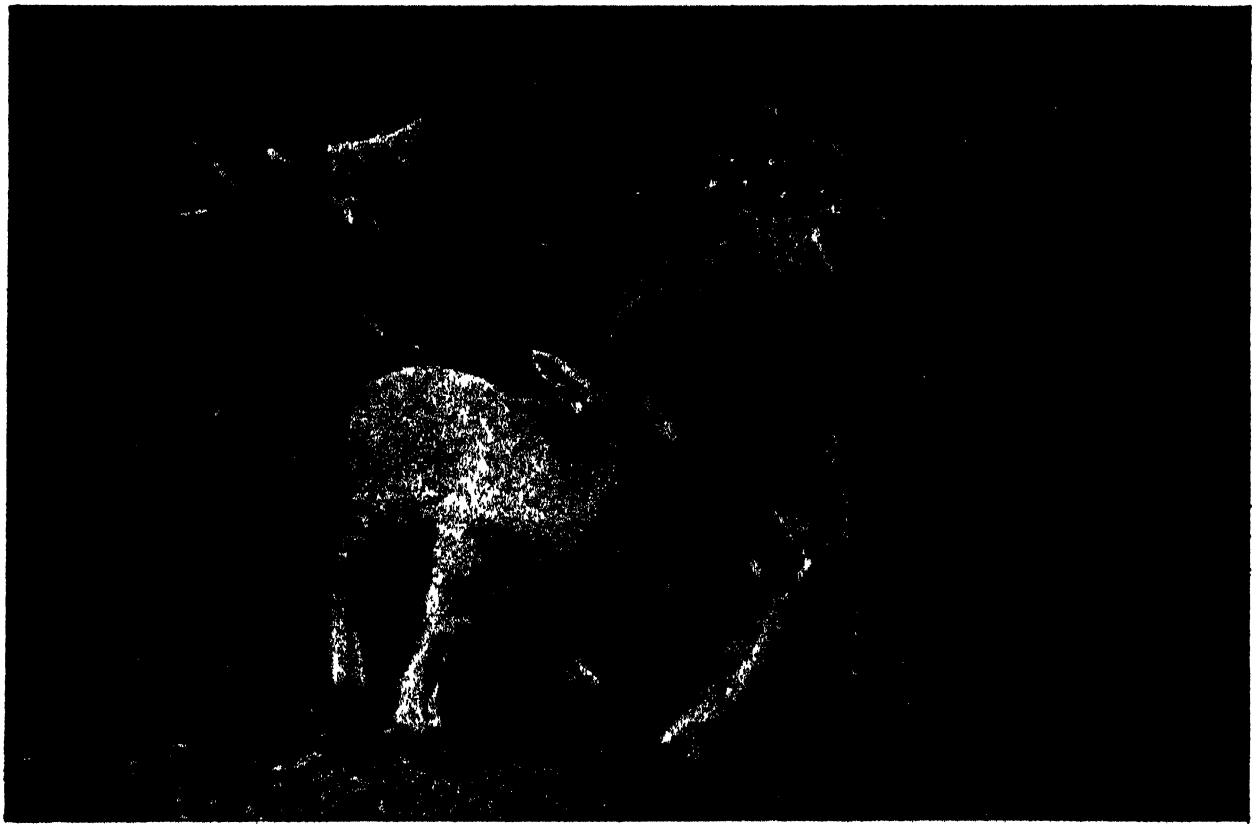
Herbert G. Ponting, F.R.P.S., Copyright

SEAL PARENTS THAT CAREFULLY TEACH THE WAYS OF THE SEA TO THEIR YOUNG

Seals are most affectionate and painstaking mothers and very interesting to watch. In the lower photograph we have both a mother and a father seal using their best endeavours to persuade their pup to enter the water. This, unexpectedly enough, it is very unwilling to do, although we find that this is usually the case with young seals. They do not take readily to the sea, and have to be taught the various lessons of the life by their mothers. Above is a Weddel seal and its pup in the Antarctic.



W. S. Berridge

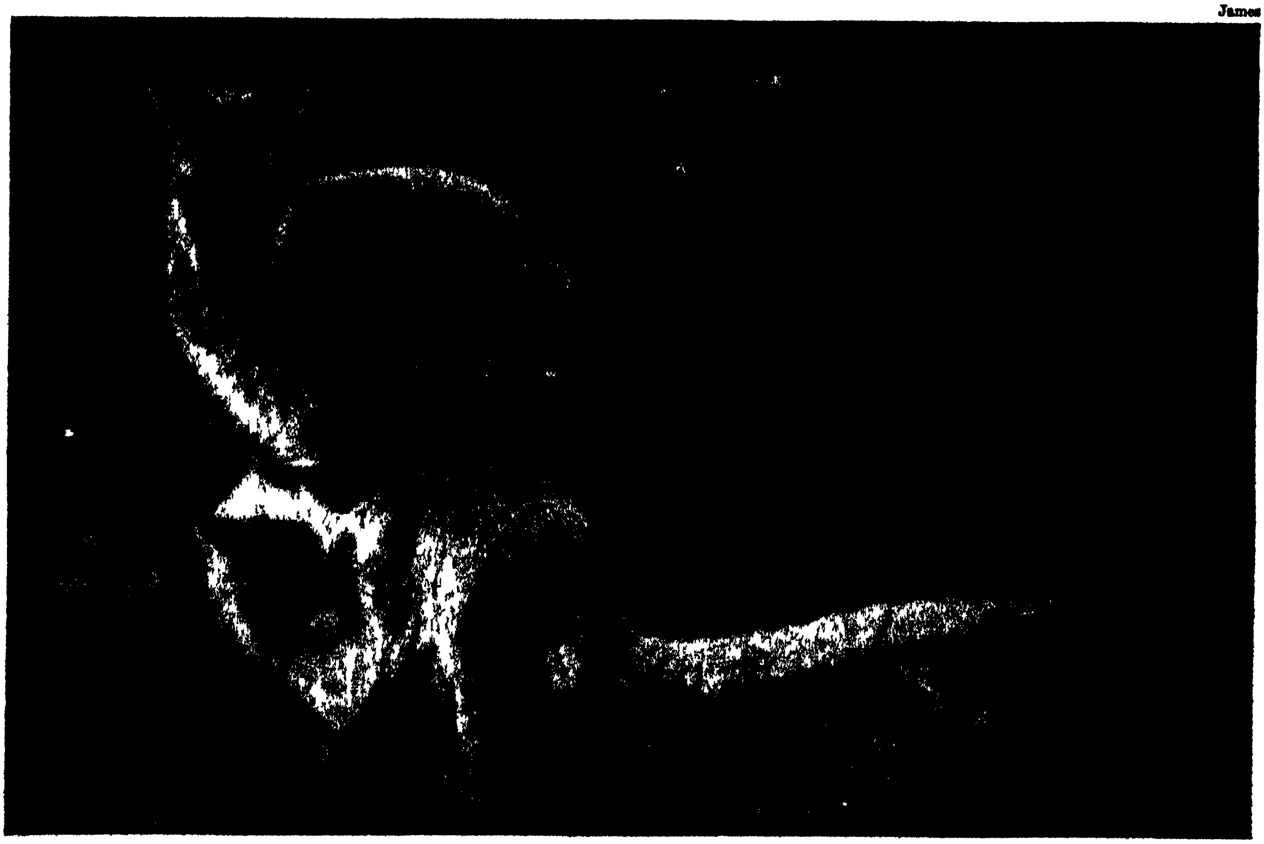


W. S. Berridge

ANIMAL MOTHERS OF INDIAN HIGHLAND AND LOWLAND WITH THEIR OFFSPRING

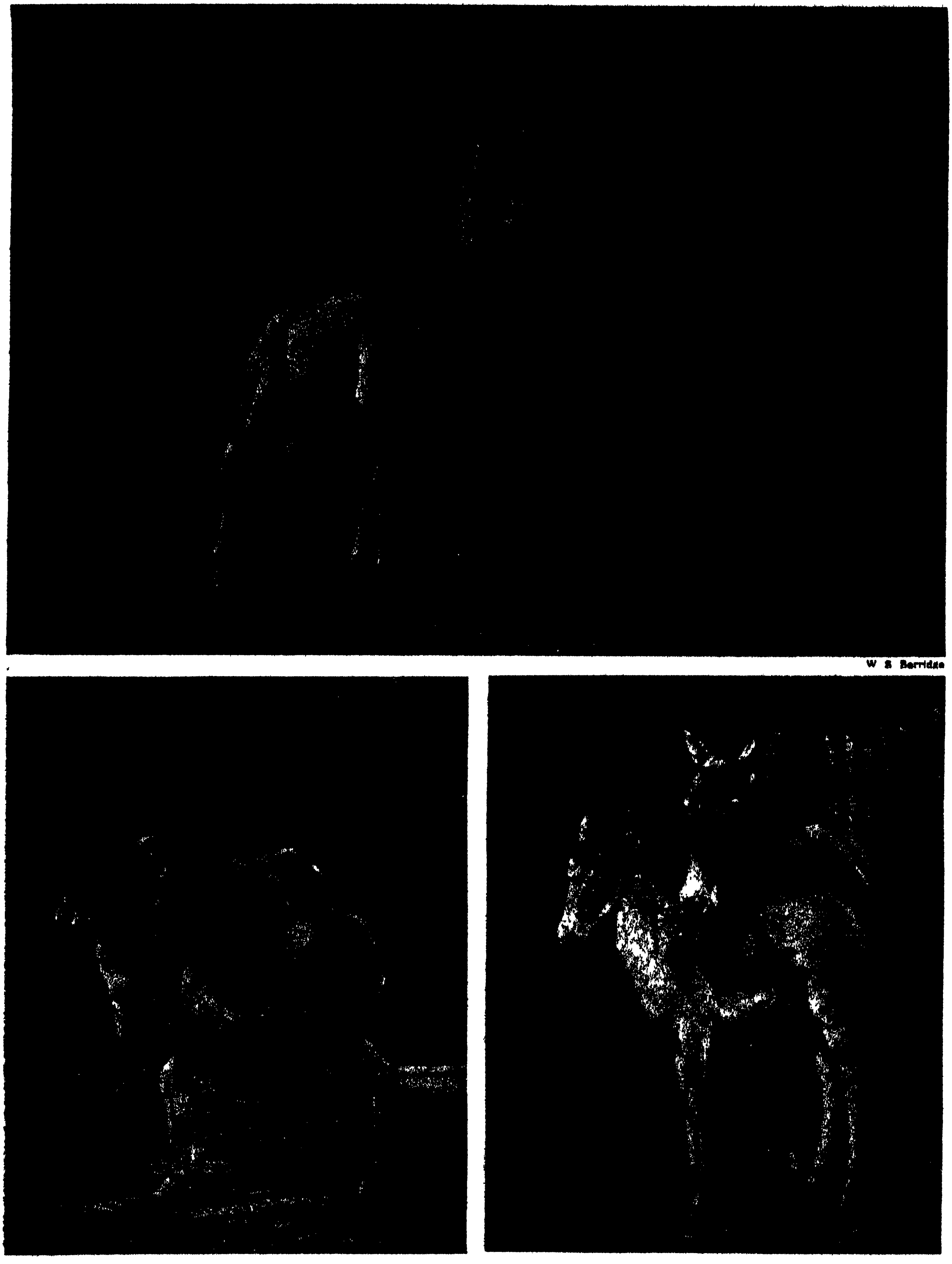
High up in the Himalayan mountains in the tract of rock and scrub between the ending of the forest and the snow line, the markhor (bottom), that fine wild goat, brings forth and rears its young. On the other hand, the nilgai, the largest antelope found in India (top), lives in the lower hills or else in the plains. Our photograph shows a young one only ten minutes old. Nilgai mothers look after their offspring on the community system, going about in herds together, separate from the males.

James



SECURE RESTING PLACE FOR A LITTLE KANGAROO: A FOUR-HORNED SHEEP FAMILY

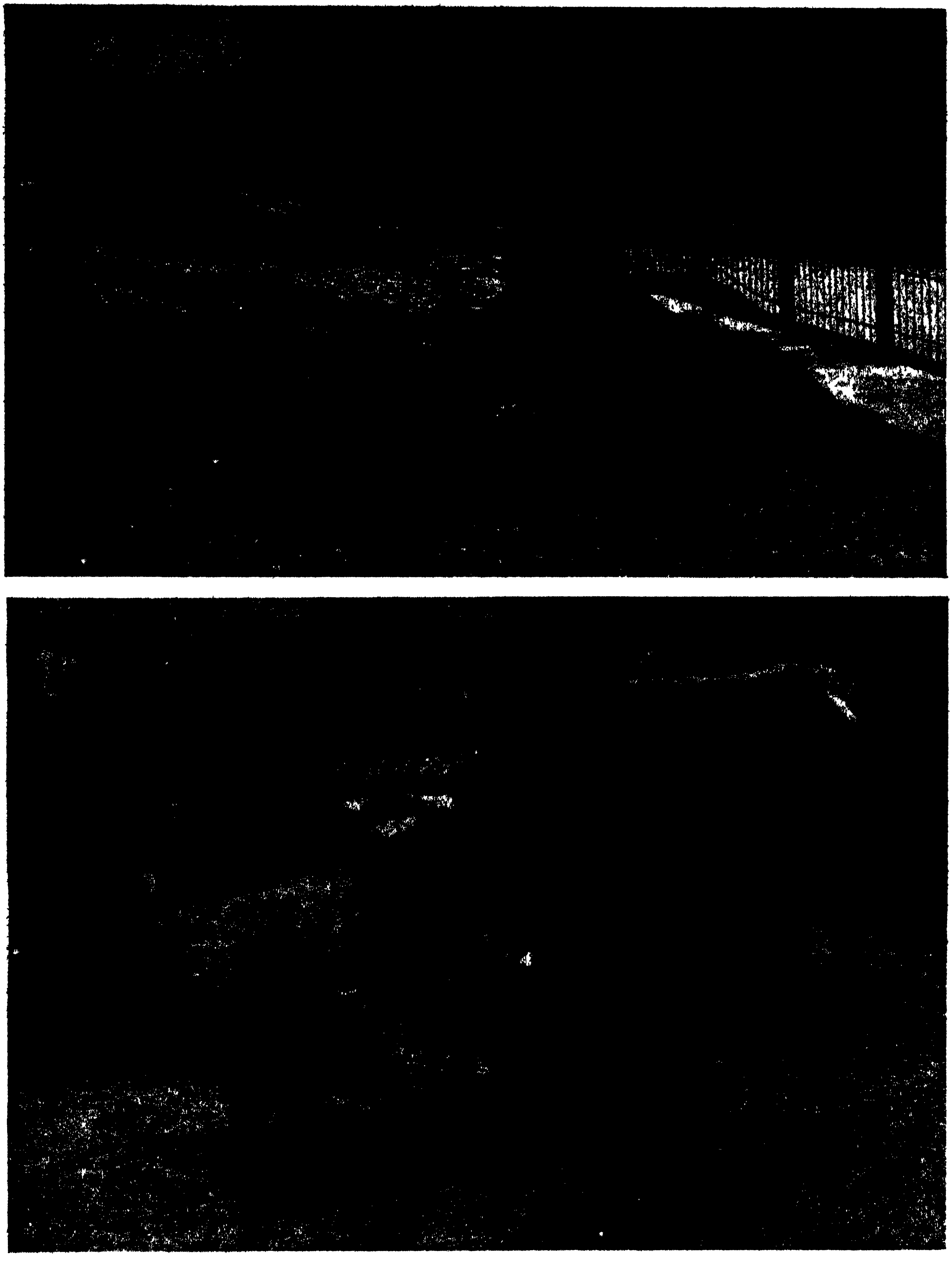
Among mothers of the animal world kangaroos are very prominent in popular fancy because of the interesting pouch in which they carry their young The sight of the little one looking out at the world from the comfortable warmth of a kind of watch pocket in its mother's coat is always most attractive to visitors to the kangaroo cage or paddock in any zoological garden where these animals are kept. The upper photograph shows two parents and a lamb of the curious four horned sheep of India.



W S Berridge

WILD ASS AND MONGOLIAN WILD HORSE WITH THEIR FOALS

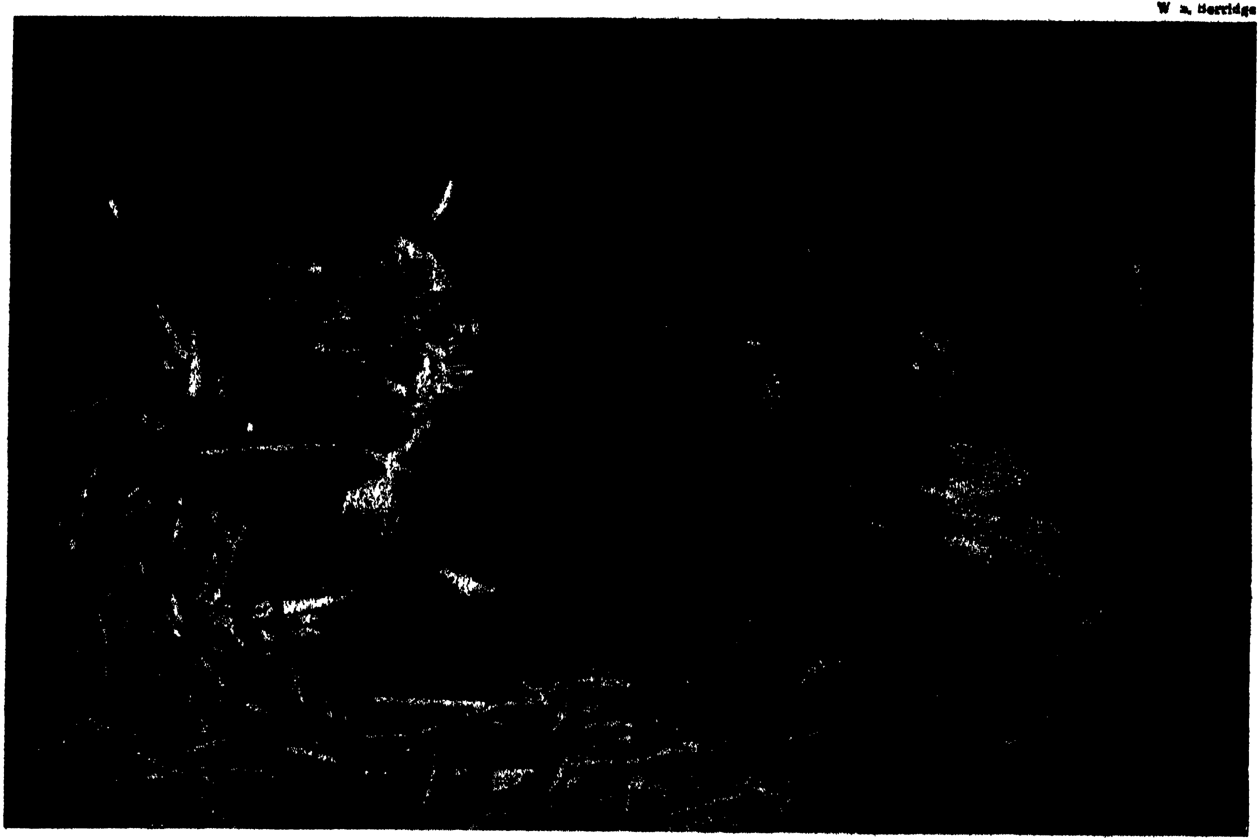
Of the Asiatic asses the finest and largest is the kiang (lower photographs). The males and females feed together with their young in a herd, with a sentinel to keep guard. The period of gestation lasts about twelve months with these animals. In the upper photograph we have a Mongolian wild mare feeding her foal. The foal has to run with its mother, and the legs are capable of sustaining it quite soon after birth. The mother teaches by force of example, and her care is no less impressive for being silent.



FOND MOTHERS FROM AMONG CATTLE DOMESTICATED IN ENGLAND AND FAR TIBET

Upon an English farm near Peterborough, this cow (bottom) successfully gave birth to three calves at once, and we see that both the mother and the triplets are doing well Attention is sometimes forcibly drawn to mother love in the animal world by its appearance, in the guise of ferocity, in the usually placid cow Cases of cows molesting human beings can usually be traced to fear or anxiety in connection with a calf Above we see a relative of English domestic cattle, the yak of Tibet, which is itself domesticated in its own country

W. S. Berridge



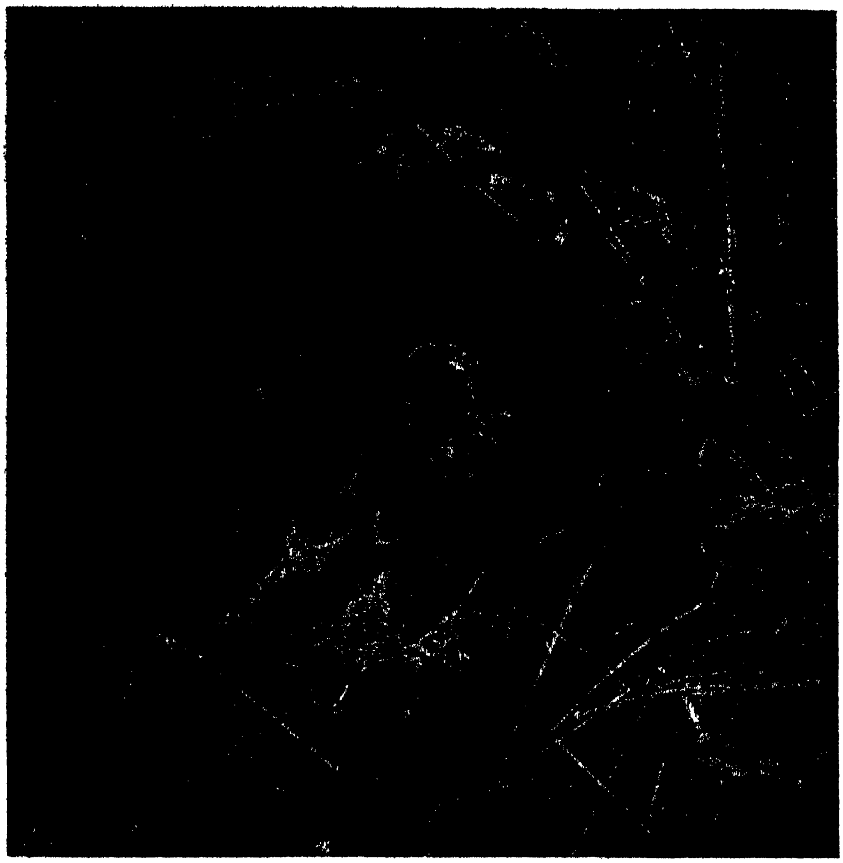
W. S. Berridge

CAT AND DOG AS FOSTER MOTHERS OF STRANGE FOUNDLINGS

A twist in the normal course of things often brings strange and startling results when it occurs to interfere with the maternal affections of the animal. The lower photograph gives us a strange instance of this with a cat that brought up a squirrel given to it in exchange for drowned kittens. In the same way a retriever is seen playing foster mother to a litter of timber wolves (top). But the gulf between the animals in this case is nothing like as great as exists between cat and squirrel.

thoughtful series of actions? I am inclined to think it is a combination of the two. I have seen a mallard duck, a tame bred one, which I knew had never been in trouble before, when surprised on her nest by an otter, tumble off and do the broken wing trick to perfection. She had no experience whatever, yet when the otter sprang at her as she sat on her eggs, she instantly behaved as if she knew all about it, floundering into the water and splashing the length of the pond in front of the pursuer, so that she drew the otter away from her treasures. It was only when she had lured it right away that she took wing, leaving the otter looking thoroughly silly.

In the case of that duck it was obvious she acted on impulse, an inherited predisposition to respond in that way when panic-stricken, and that there was no thinking out what she was about, but when a bird returns again and again, as my pintail duck did, and as I have seen a golden plover do, deliberately to repeat its endeavour to draw peril to itself and away from its offspring, surely we see intention as well as instinct—true mother love driving the parent to dare even the final sacrifice for her young ones?



A. H. Willford

THRUSH PARENTS ATTENDING TO THEIR NURSERY

Birds being, as we say, lower down the scale of life than mammals, have to go out and get food for their young when they are mothers. The work is very hard and very exhausting for the parent. All through the spring day it never ceases. A cluster of gaping beaks waits, shrieking impatience, the successful end to each little hunting excursion.

Mother love has queer manifestations at times, as when under stress of extreme fear and excitement the distraught old one destroys her own family. I have seen a meadow vole (the little furry brown field mouse known to scientists as *Microtus agrestis*) slay her young ones, biting each in turn until she had killed it; and have known cases of the domestic pig, dog, ferret, rabbit, badger and other mammals destroying their offspring. Some perversion of their love, perhaps the feeling that they must keep their babies safe, drives them to the awful deed. But from such a horrid subject let us turn to more pleasant things, for instance the manner in which various animals care for their young ones.

Birds, of course, take first place with regard to elaborate nurseries, their wonderful and beautiful nests having no parallel among the mammals. Such nests as that of the weaver bird, or the European long-tailed tit are exquisite structures. The latter is a marvel of bird architecture. I examined one, the whole nest weighing less than an ounce, and found its walls were a thin but elastic structure of moss, spider cocoons and lichen, while it was lined with feathers. These feathers were drawn out one by one and carefully counted. They numbered 1,144! What a nursery for the delicate eggs, and the little birds that hatched from them. Even a common song-thrush's nest is an elaborate structure, with its grass walls and clay-lined cup; but however hard the birds work on behalf of their coming young ones, preparing wonderful nurseries, it is nothing to the way they work afterwards when the babies have to be fed. There is no rest for the parents then, life becomes one long labour collecting caterpillars and other grubs to push down the ever eager beaks, beaks that open so wide, and are held up in such anxious appeal. With those hungry beaks always waiting for more, the poor devoted parents have to work harder than ever. No wonder that when the spring days wane many a little mother bird finds herself almost worn out by her unflagging devotion.

Yet devoted as bird parents are, despite the anxious care they give to their nestlings, there is one thing the majority cannot do, and that is move the family to a new home. The bird's nest must be occupied until the nestlings are ready to go

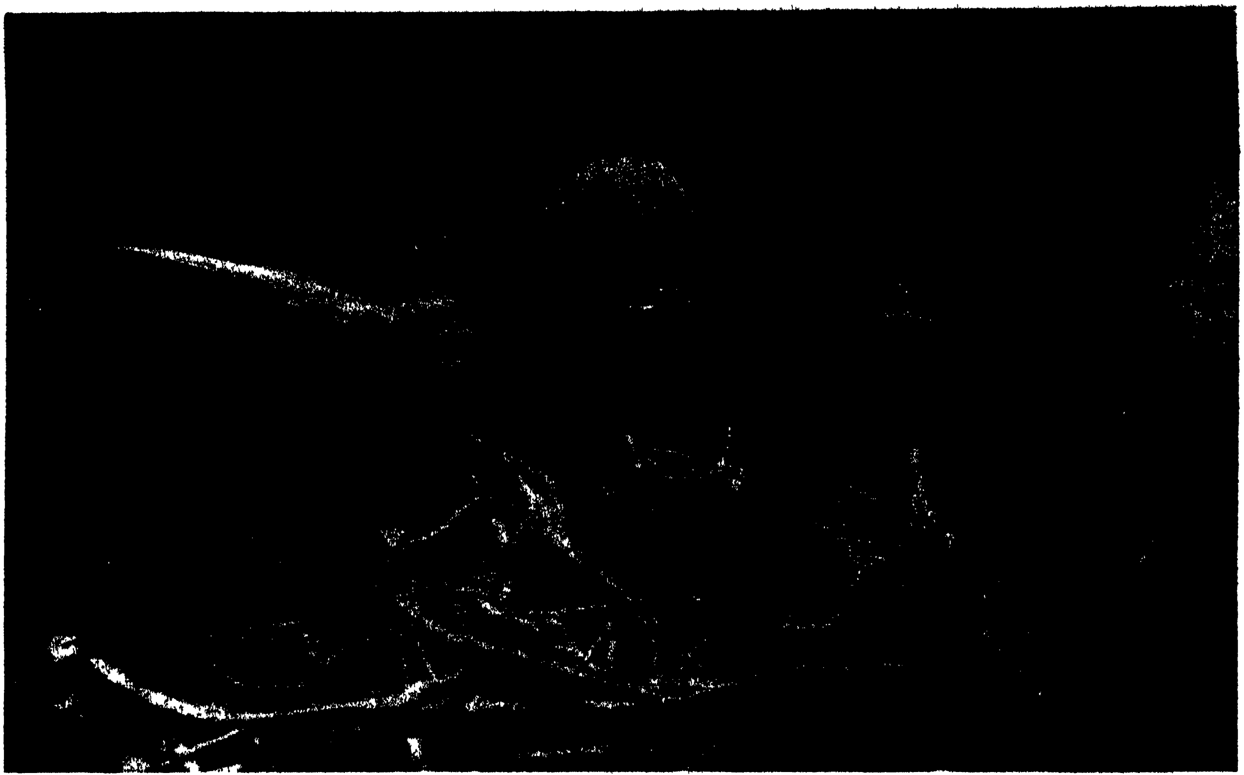
BIRDS ONCE HELD TO BE SHINING EXAMPLES OF MATERNAL CARE: A PEACEFUL COLONY OF PELICANS

In the days when the animals were considered to have certain almost fairy qualities—they might, for instance, suddenly begin to speak, and usually very much to the point—moral lessons were frequently drawn from them and many birds and beasts had each a special virtue or failing. The pelican was the great example of maternal virtue. The bird was supposed to feed its young, if necessary, with its own flesh and blood. Actually, what happens is that it opens its beak and lets the fledglings swallow the fish in its huge pouch. Our illustration shows a pelican colony on an island and is from a photograph by the American Museum of Natural History, New York.

C. Reid

SWAN FATHER AND MOTHER, WHICH DEFEND THEIR FAMILY WITH THE UTMOST FEROCITY

Let anyone who doubts the power of motherly care interfere with a swan when she is on her nest or has her cygnets with her. Swans have always been noted for truculence, and they may treat the owner of a piece of ornamental water who has given it them for a home as rudely as any interfering terrier. Here we see a family afloat on an English river. The mother will deign to receive food for herself and family, but all the time the wings will be a little raised and spread as though the bird might fly into a rage at any moment. Swan mothers have an alarming habit of flying so that their wings hit the water in a series of terrifying claps when they wish to drive off an intruder



F. Vear

MOTHER HEDGE SPARROW FEEDING ITS HUNGRY CHILDREN

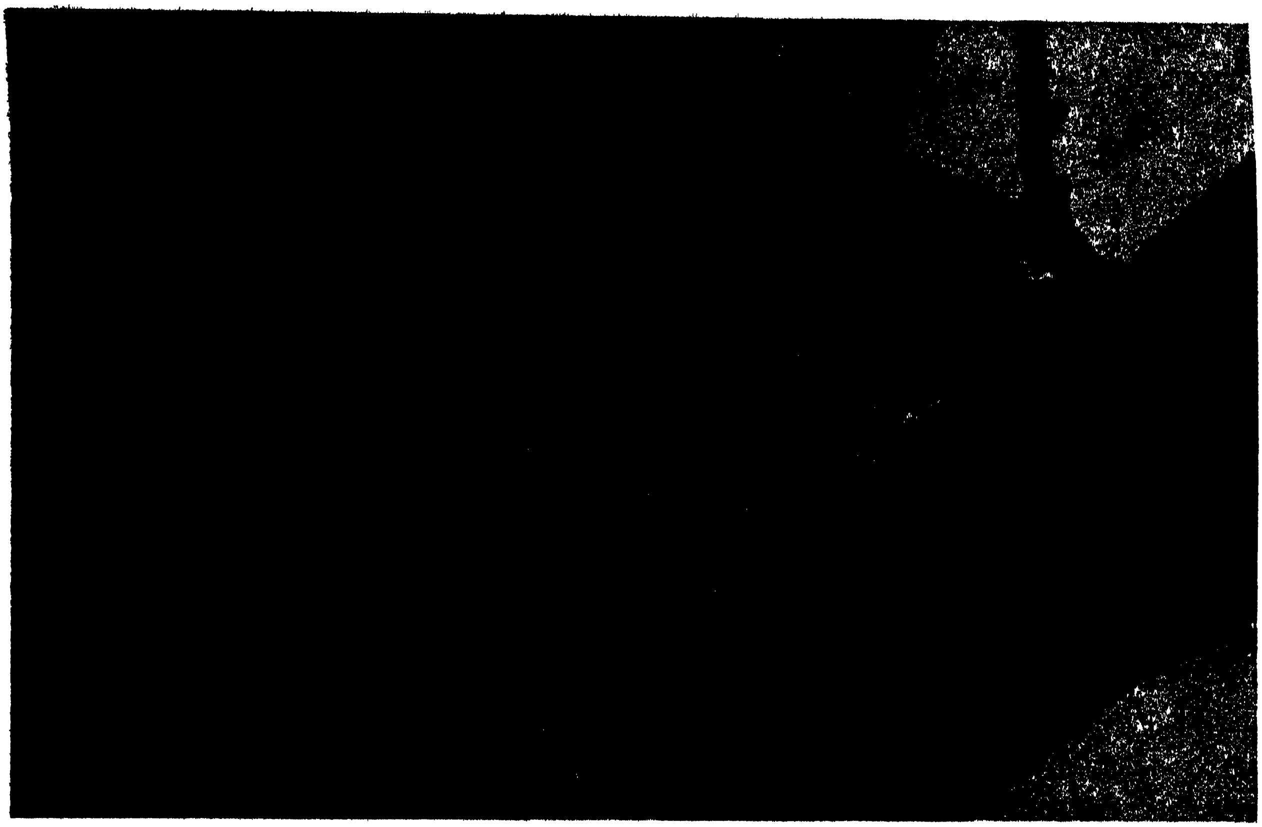
Low down, near the ground, the hedge sparrow—which is no relation to the house sparrow—builds its nest of moss, or roots lined with hair or wool. Its care for its little ones is shown in the painstaking labour with which this hedge cradle is constructed, and afterwards by the ceaseless hunt for food. Hedge sparrows often have an extra burden thrust upon them, for the cuckoo is very fond of a hedge sparrow's nest—probably because of its easy accessibility—as a place in which to lay its changeling egg.

forth into the great world; but the four-legged creatures think nothing of changing house.

One of the prettiest removals I have seen was that of a squirrel family. There was a tall and very thick fir tree close to the house, and in the top of this spruce was a squirrel's nest, or, to use the correct word, a "drey," but I did not know it was a nursery until one morning when I was looking out of a window and saw something red moving in the tree-top. Watching, to see what the squirrel was about, I saw her come running down the trunk, but more slowly and carefully than a squirrel usually moves. She neither sprang from bough to bough, nor dashed headlong downwards; then as she came to an open space, where I could clearly see her golden-red form through the dark green fir branches, the reason of her care was apparent, she was carrying a little squirrel in her mouth! It was quite a well-grown youngster, and as much as she could carry. No wonder she had to descend with care. She bore it by the loose skin at the back of its neck, as a cat carries a kitten, and it hung limply in her grasp, its little red tail curled up and curved over her head. Slowly she went down the tree, slipping the last few inches of trunk and landing on the turf with a run, when she scampered off across the lawn, to the shrubbery on the further side, where she disappeared with her burden into the bushes and trees.

Waiting and watching I presently saw her reappear, race back across the turf, ascend the spruce, and bring down another youngster, which was carried off like the first. How many she had taken before I cannot say, but she was evidently removing the entire family. Why, is another question. Was the old nest too close to the house, in too public a position, and did she therefore build a new drey in the plantation? I cannot say, all I know is that the new nest, which I subsequently found, was an elaborate one, well built and bulky, up a Scotch fir, and it must have been hard work carrying her well-grown babies up to it; but, then, mother love does wonders.

MANY mother animals will carry their young away from what they consider a dangerous neighbourhood to a new home, creatures so diverse as foxes, wolves, lions and tigers, doing so after the manner of the household cat, that is, bearing each baby by the "scruff of its neck." It is a curious fact that little animals never kick or struggle when picked up by this loose skin. They seem to have the notion implanted in them that this is the right part to be carried by, and even when they have become adults they never forget it. If you are handling a wild animal, and can get hold of it by the back of the neck, it usually stops struggling, and hangs limply in your grasp as if it remembered its infancy.



F Vear

Mondiale

FALCON AND MISTLE THRUSH, FIERCE DEFENDERS OF THEIR BROODS

A nest-full of young birds takes a deal of looking after Our lower photograph is of a falcon which has just brought home a tasty morsel for its hungry brood Above we have a mistle thrush with its young. This bird is extremely courageous in defending the nest from such bandits as jays and magpies, birds considerably larger than itself It will fly at these enemies without hesitating, and seems always to succeed in driving them off. There are usually about four or five eggs laid at a time and, in the South, two broods are raised each summer

F. Vear

J. Shepstone

EGRET AND WILLOW WREN MOTHERS

Young egrets (bottom) have nowadays a little less chance of being starved because the mother has been killed for the millinery value of her feathers. Above is a willow wren whose matronly care has conquered distrust of the human hand.

But it is not of adults, as such, but of mothers and their young that I wish to write, and in particular of the cosy quarters some creatures prepare for their babies. The common rabbit makes the warmest of nests for its litter, either scratching a special hole, or using one already made, and carrying a considerable quantity of grass to the end of the tunnel. This bedding, however, does not content the doe; she proceeds to line the nest, plucking the soft, silky wool from her chest and underparts until the most perfect of couches has been prepared, so soft and warm that even the naked, blind, helpless young rabbits are kept perfectly snug and cosy. Yet even then their mother is not contented, and when she leaves the family, does her best to close the door behind her, so that cold air, to say nothing of enemies, may not enter. She scratches back all the soil she loosened when excavating the burrow, and fills up the mouth of the hole with this earth. Only when all is level does she venture to go away and nibble some grass.

In contrast with the care the old rabbit devotes to her little ones, the hare seems a casual mother; but then the latter's young ones are born fully clad, the prettiest of furry mites, and it does not matter to them if they have to sit out in an open "form" in the middle of a wind-swept field.

Of course, the most undeveloped of young mammals at birth are those of the kangaroos and certain other marsupials, but in their case the dam is mother and nursery in one, carrying her helpless babies in a special pouch, to which they cling for some time, even after they have grown comparatively strong and active. It is very quaint to see a kangaroo mother, with two or three little ones peeping forth at the world from their snug refuge.

Chapter CXV

The Marvel of the Mammoth and the Mastodon

By J. R. Ainsworth-Davis

Formerly Professor of Zoology, University of Wales

One of the most interesting of the extinct monsters of the past was a huge elephant, the mammoth (*Elephas primigenius*), which ranged through the Northern Hemisphere for perhaps half a million years in those remote times when Siberia was continuous with Alaska, the North Sea was a fertile plain, and the British Isles were part of the Continent of Europe. The race died out completely somewhere about 15,000 years ago, its last stronghold being in Northern Siberia, among the frozen wastes known as tundras.

Prehistoric man, in the Age of the Mammoth, was a wandering hunter, using stone implements and weapons, and leading a precarious existence among formidable wild animals. But he nevertheless possessed a strong artistic sense, as attested by many engravings on ivory, bone and stone, together with spirited drawings on the walls of caves, these being particularly abundant in France and Spain. In May, 1864, the French scientist Lartet discovered, in the cave of La Madeleine (Department of Dordogne), a fragment of mammoth tusk on which some early hunter had scratched a rough but vigorous outline of the tusk's owner, obviously a hairy elephant. This created much discussion, for existing elephants are notably devoid of well-developed hirsute covering. The subsequent discovery of similar engravings on the walls of other caves in the same district added further evidence as to the former existence of such a creature. These interesting representations were probably executed by the "medicine men" of the period, as magical spells for securing success in hunting, if we may judge from practices of the kind still resorted to by some primitive peoples.

Our knowledge of the mammoth is now pretty complete for Nature has anticipated the methods of refrigeration which now enable Australian beef and New Zealand mutton to compete with our home-grown products, and mammoths which have been in cold storage in north Siberia for many thousands of years are from time to time discovered. Ides, a Dutch collector of mammoth ivory, came across a frozen head and foot as far back as 1707, but the first complete cold storage specimen was found on the banks of the River Lena in 1799, and was very gradually thawed out in the course of a few years.

Baron von Meydell discovered no fewer than three such frozen animals in north-east Siberia in the course of 1869, since when others have been brought to light. So perfectly have these prehistoric creatures been preserved that dogs, foxes, and wolves devour their flesh with gusto, and in at least one instance it was possible to find the nature of the last meal eaten by examining the contents of the stomach. It is extremely probable that mammoth steak has now and then been eaten by human beings in comparatively recent times, and there is a legend to that effect among American Indians.

Smithsonian Institution

MAMMOTH'S FORE FOOT

Although mammoths were, on an average, not so high in the leg, and therefore not so tall as the African elephant of to-day, they were much bulkier beasts. This forefoot is nearly as large as a man. The bone structure can be seen.

Smithsonian Institution

PART OF A MAMMOTH DISCOVERED ON A CLIFF

Whereas the ordinary weight for a tusk of an African elephant is from forty to fifty pounds—though exceptional specimens may weigh a good deal more—the mammoth sometimes had tusks ten feet long and weighing two hundred pounds. Here we see part of a mammoth carcase discovered on a cliff. The body was covered with a reddish wool in life

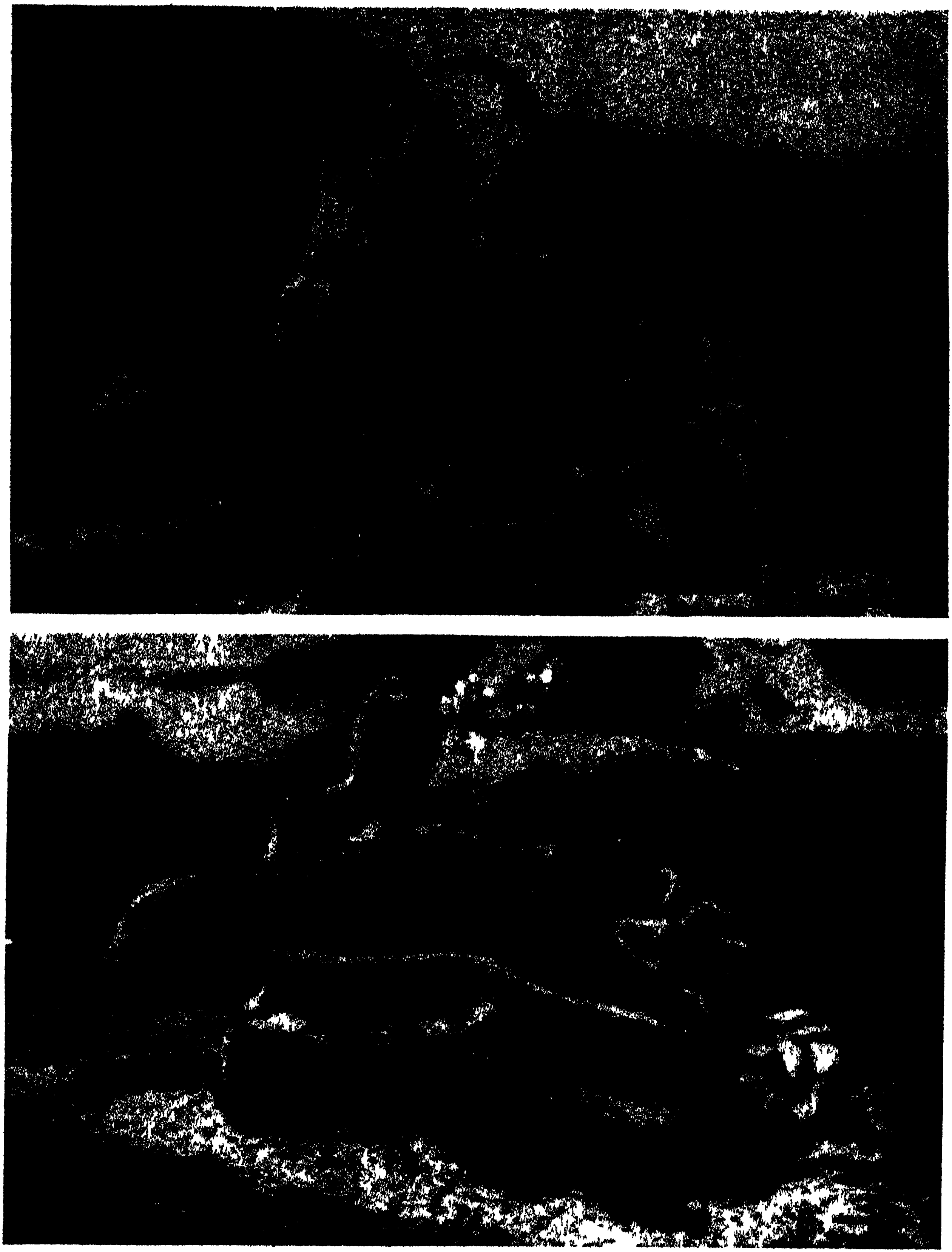
These extinct monsters apparently came to grief by falling into snow-filled ravines from which they were unable to extricate themselves, ultimately getting frozen up. The evidence afforded by them enables us to form a good idea of what the mammoth was like, and how it lived. It may be described as a super elephant, for though average specimens were not much more than nine feet high, some attained a much greater stature and the curved tusks sometimes reached a length of nine or ten feet, and a weight of from 180 to 200 pounds. In the existing African elephant an average tusk weighs from forty to fifty pounds, though this may be greatly exceeded in exceptional specimens.

The body of the mammoth was thickly covered with a kind of reddish wool and long black hair, and this is intelligible when we remember that the climate of the Northern Hemisphere was much more rigorous in those days than it is at the present time, and the contemporary "woolly" rhinoceros was also provided with a great-coat. The ears were comparatively small and the tail short, while the little cunning eyes resembled those of an ordinary elephant. Like all his kindred, the mammoth was a vegetarian, subsisting chiefly on the leafy branches of pine, fir and willow though he did not disdain a meal of grass, wild thyme, and even flowers, for seeds of poppies and buttercups have been found in his stomach or sticking in his teeth.

The mammoth was not only contemporaneous with man, but also contributed to prehistoric human diet, for his bones—some of them cracked for the extraction of marrow—are sometimes found associated with flint implements. Probably the ancient hunters constructed huge pitfalls for the undoing of their huge quarry, whose extinction is by some attributed partly to human agency.

The nature of the skeletons of this great creature found in Europe long ago was often misunderstood. One discovered in the eleventh century was identified with Pallas, son of Evander, a mythical giant of classical times: the "Giant of Lucerne" (1577) 19 feet high, and the "Giant of Dauphiné" (1613) were merely mammoths; and heated debates arose about some mammoth bones disinterred near Gloucester in the reign of James I, and asserted by some enthusiasts to be of giant human nature.

From very remote times mammoth ivory has been an important article of commerce, the early Greeks, for example, being well acquainted with the tusks as a



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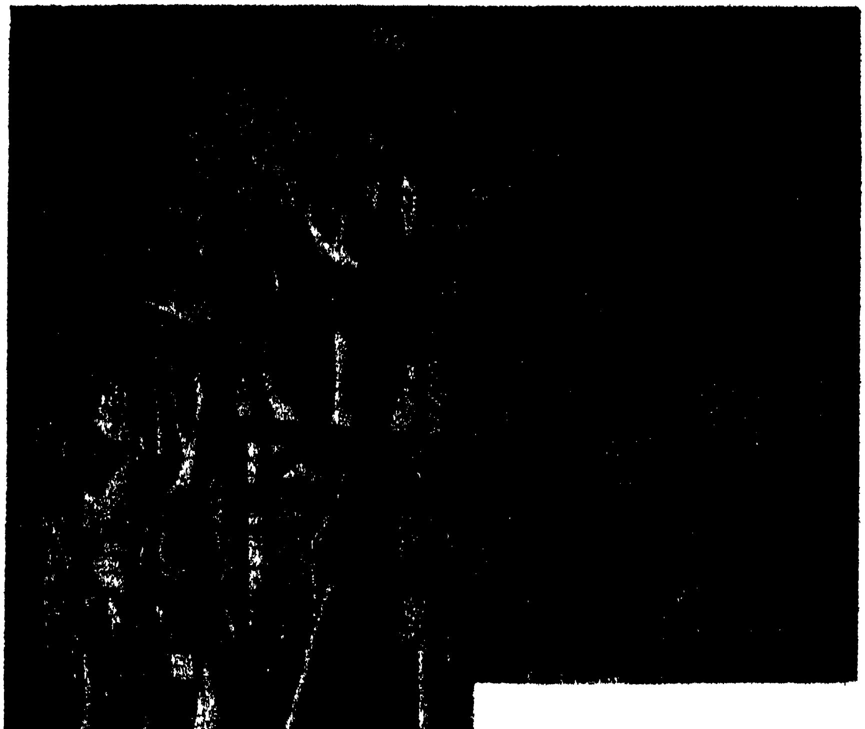
PARTIALLY EXCAVATED CARCASE OF A MAMMOTH IN SIBERIA

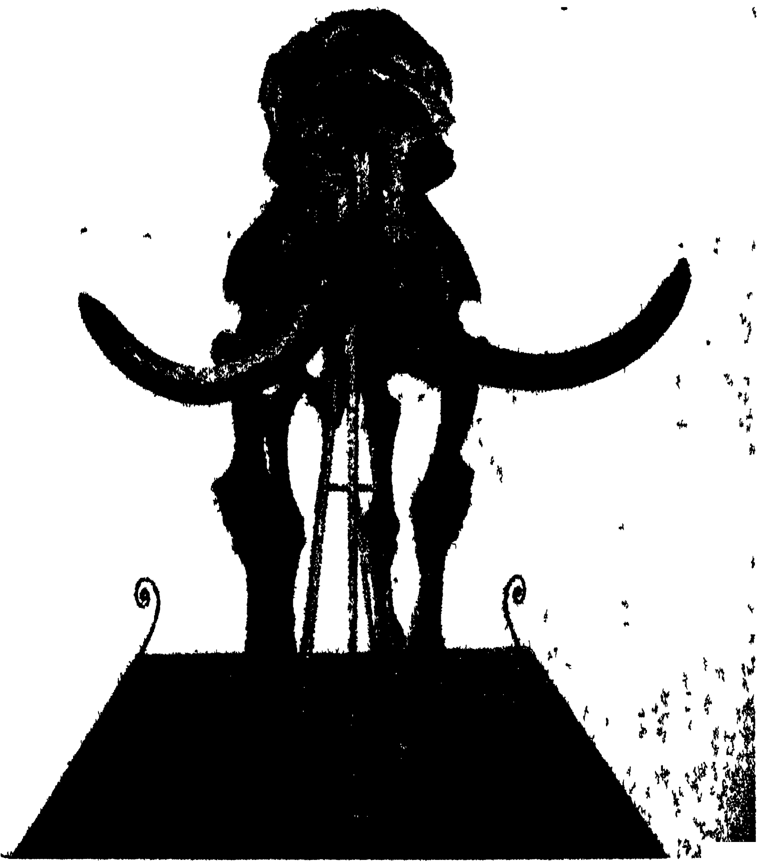
Siberia was the last dwelling place of the mammoth before it became extinct about 15,000 years ago The representatives of the race which have come down to us are those which accidentally fell into depressions hidden by snow and were unable to get out The one seen here, partially excavated, was a fine specimen. In the lower view it is photographed from behind and we can see the hollow body cavity and the hindquarters nearest the camera Above is a side view The animal is leaning over on one flank



valuable commodity Even at the present day they are an important source of ivory, and Bassett Digby has recently written a most interesting book about his experiences as a hunter of mammoths in north-east Siberia, especially in the New Siberian or "Ivory" Isles of the Arctic Ocean There are many curious beliefs about the mammoth among the primitive races inhabiting Siberia It is thought to be a gigantic burrowing rat, whose tunnelling movements are responsible for earthquakes. When a specimen is discovered, weird incantations precede any attempt to secure the tusks, for the supposed "rat" is also regarded as a powerful and malign demon.

Much research of the most interesting kind has been devoted to working out the genealogy of elephants One interesting species, the straight-tusked elephant (*Elephas antiquus*), was an ancestor of the mammoth that lived in Britain before the onset of the long cold period known as The Great Ice Age. It attained a height of twelve feet seven inches, and part of a skeleton has been mounted in the Natural History Museum at South Kensington.

Still older are the mastodons, which once ranged through the Northern Hemisphere. In these the grinding teeth were smaller and simpler than those of the mammoth, and there were tusks in the lower as well as in the upper jaw. A very remarkable member of this group is the "shovel-toothed mastodon" discovered by the American scientific expedition to Mongolia. The remains were found in a hill range adjoining a vast desert, which was a lake long ages since, fringed at that



SKELETONS OF SIBERIAN AND AMERICAN MAMMOTHS

In the lower photograph we have a mammoth's skeleton dug up at Beresovka in Siberia It is now in a museum at Leningrad Notice the outward curving tusks The tusks of the American mammoth (top) from Indiana, are nearly semi-circular in shape This animal was ten feet six inches high at the shoulder.

Smithsonian Institution

James

MAMMOTHS RECONSTRUCTED BY TAXIDERMY AND PAINTING

At a museum in Leningrad we may see the famous Beresovka mammoth mounted in the exact position in which it was found (top) The terrific cold of Siberia—the lowest temperatures on record have been found there—has been responsible for the wonderful state of preservation in which these mammoth carcases have been kept for something like one hundred and fifty centuries The lower illustration is from a painting representing a mammoth in its natural surroundings of the frozen Siberian wastes.

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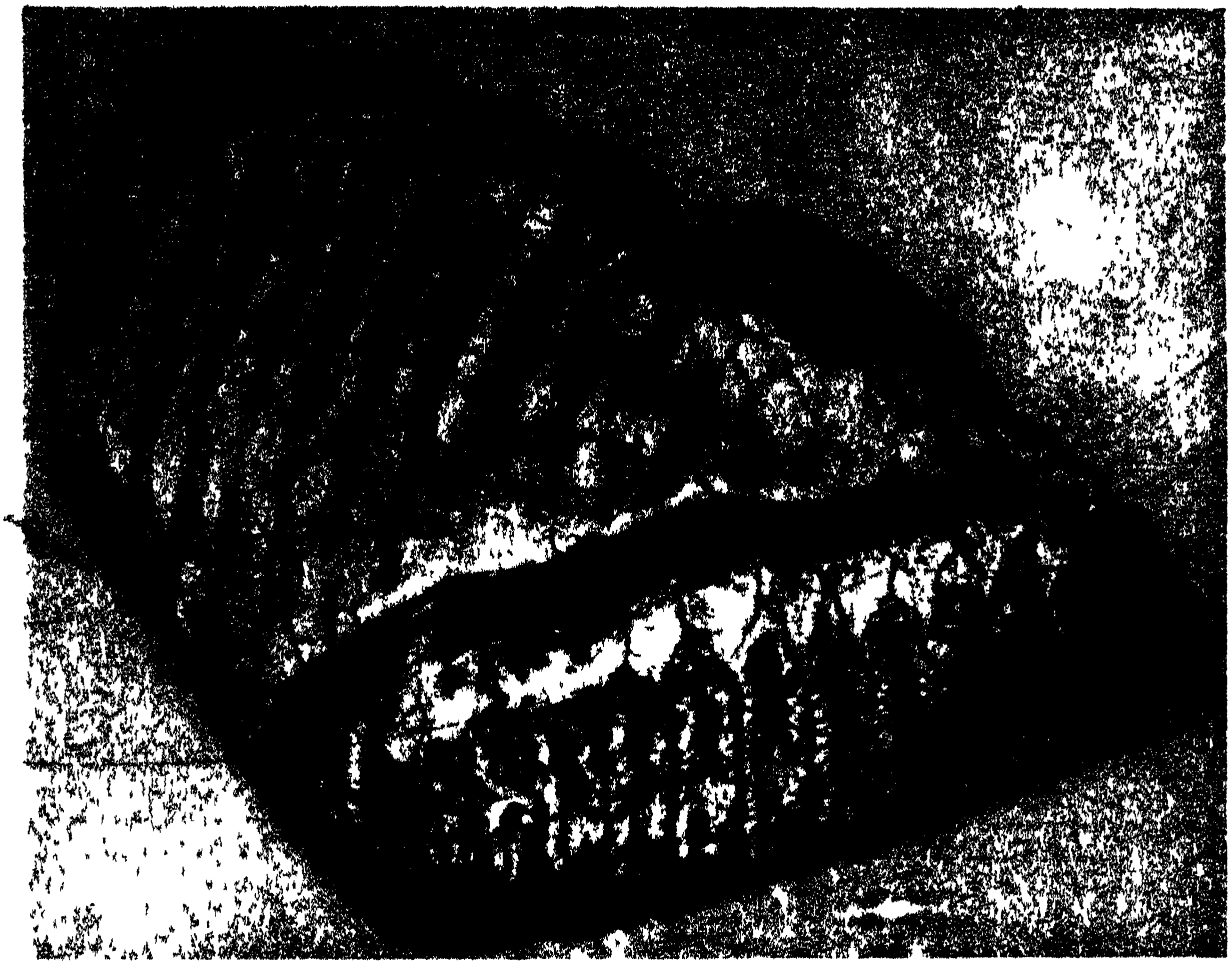
FOOT, AND SKULL WITH FOOD STILL IN THE TEETH

Nature's cold storage has wonderfully preserved the mammoth remains in Siberia. Here (bottom) we have a right hind foot, while above is a skull, photographed where it was unearthed. And here we find an amazing thing The food of the monster's last meal, 150,000 years ago, is still between its teeth, and is marked in the photograph with a cross.

time by luxuriant vegetation. The lower tusks of this new find were flattened out into what looks like a coal scoop over six feet long, provided with a cutting edge in front, and narrowing behind into a "handle." This peculiar apparatus was apparently used for cutting through and shovelling up into the mouth the succulent plants growing at the edge of the lake. Both trunk and tongue must have helped in the operation.

Many other kinds of four-tusked elephants are known, the older ones, like our shovel-toothed friend, having long chins and elongated lower tusks, while in the youngest members of the series the chin and lower teeth were quite short. The grinding teeth became larger and more complicated as time went on. - The mammoth and existing elephants were derived from the last four-tuskers by still further



ONE OF THE ENORMOUS TEETH FROM A MAMMOTH'S UPPER JAW

As reproduced here this tooth is about one quarter of the natural size It is one of the huge molars in the upper jaw and its long surface consists of a series of irregular ridges worn down by the constant grinding of the vegetation which formed the mammoth's food. The tooth came from a carcase found in the frozen tundra of Siberia and is now in a private collection. It measures about eight inches along the top or grinding surface, which is about two and a half inches broad, and its greatest length is about eleven inches It weighs some twelve pounds

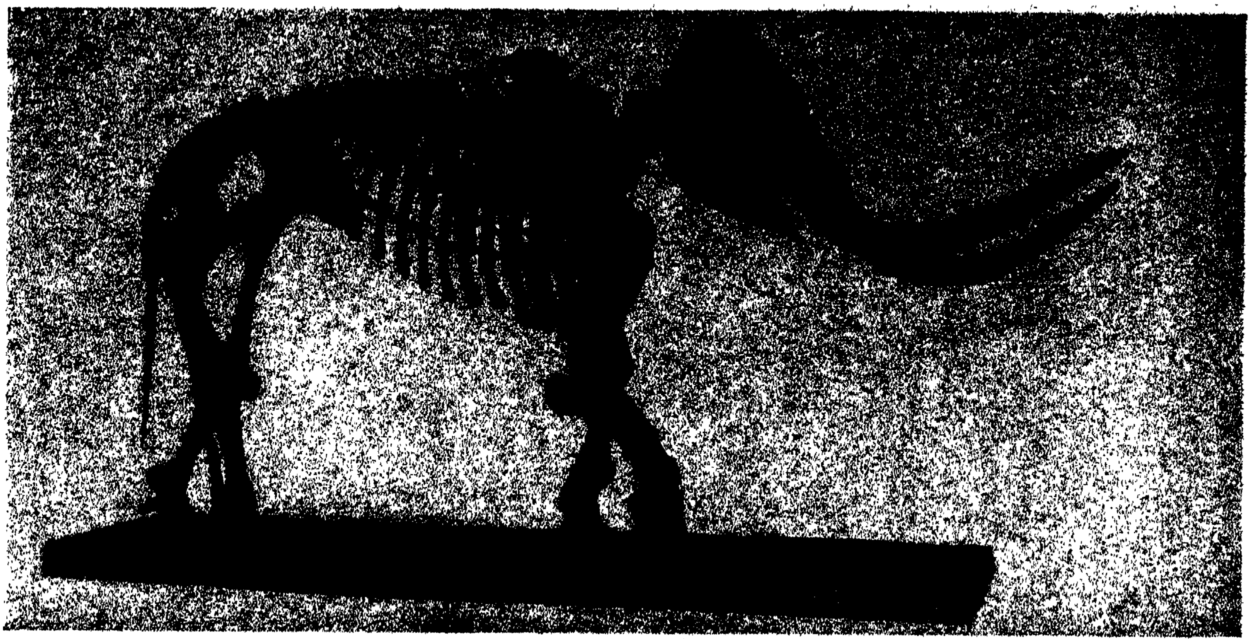
shortening of the chin and suppression of the lower tusks; while the grinding teeth increased in size and complexity, so that ultimately only four of them could be in place at the same time.

During the heyday of the mastodons a curious creature, the dinotherium, came into existence in Europe and Asia, as a sort of unsuccessful experiment in the evolution of elephants, for it became extinct without leaving descendants. Here the upper tusks were suppressed, while the end of the lower jaw bent sharply downwards and bore a pair of sharp backwardly curved tusks possibly used for digging.

We have seen how ordinary elephants have taken origin from mastodons, and must now enquire where and how the latter came into existence. Our evidence on these points is derived from fossil remains found in the ancient fresh-water deposits of Egypt. Here we find the bones of an extinct creature, palaeomastodon (meaning " old mastodon "), which was about the size of a small elephant and possessed a short trunk. There were two small tusks in the upper jaw, and two pointed front teeth in the elongated lower jaw, used for grubbing in the ground. The grinding teeth were smaller and more numerous than in mastodons, and much like those of a pig.

This species, in its turn, was preceded by a much smaller and less specialised form, moeritherium, which appears to have resembled a tapir in size and appearance. There was a short trunk, and strong tusks in both jaws. We see in this creature the first beginnings of the characters that distinguish elephants and their kind. The subsequent stages in evolution are easy to understand. There was a gradual increase in size, and the necessary support for a bulky body was secured by the conversion of the limbs into strong pillars lacking flexibility, and with no external trace of digits save small hoof-like nails.

At the same time some of the front teeth were converted into weighty tusks, the evolution of which was incompatible with an elongation of the neck sufficient to bring the mouth down to the ground to graze. Hence the development of the snout into a flexible trunk for seizing food.



Natural History, N.Y.

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CAREFUL RESTORATION OF AN AMERICAN MASTODON AND A SKELETON

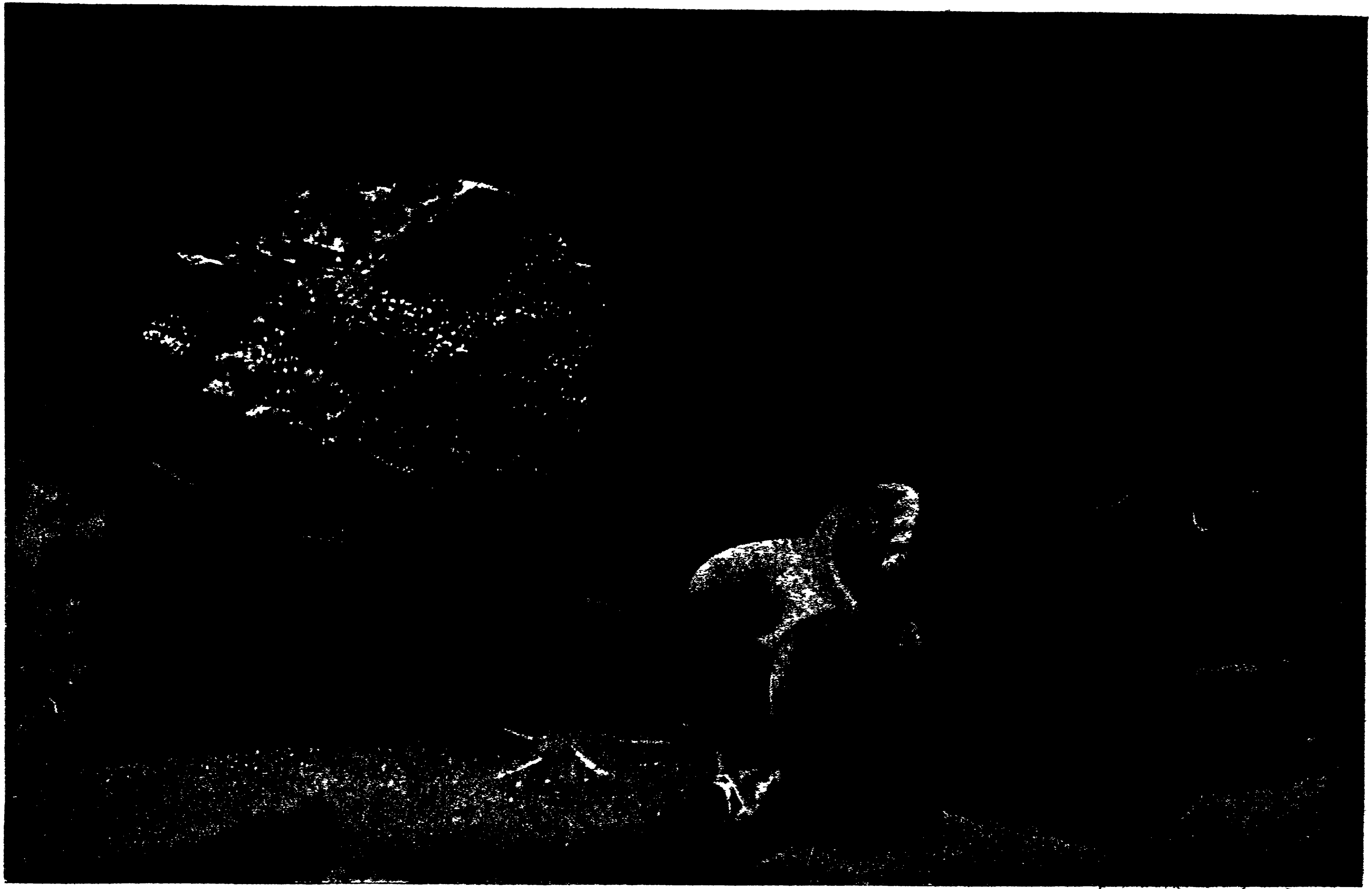
Based on an exhaustive survey of muscles and other anatomical details and from very precise measurements of skeletons, this is a restoration of an American mastodon, an animal much older than the mammoth, which had much smaller and less elaborate teeth. The mastodon had a hairy coat to withstand the severe climate in which it lived. This specimen lived in New York State in the Ice Age and may have been as common then as the buffalo in the early nineteenth century. Above is a mastodon skeleton nine feet two inches high.

Natural History N Y

James

MASTODON REPRESENTED IN ITS NATURAL HAUNTS, AND A MUSEUM MODEL

Mastodons were, like their distant relatives, the elephants of our own day, fond of water, and this picture, painted from scientific data (bottom) shows the kind of surroundings which the mastodon liked Above is a model of a mastodon in the American Museum of Natural History in New York. It was a shorter animal than the elephant and there were, in some kinds of mastodons, tusks in the lower as well as the upper jaw The name mastodon means "breast-toothed" and refers to the conical tubercles on the teeth



COURTSHIP CONTORTIONS OF THE HANDSOME SPOTTED DOG-FISH THAT SWIMS THE NORTH SEA

Growing to a length of not much more than two feet, the spotted dog-fish is the smallest member of the shark family found in the North Sea. It is an elegant fish, and its smooth, grey sides are softly tinted with red and decorated with handsome markings in the shape of spots. Although related to the viviparous sharks—those that bring forth their young alive as complete individuals—the spotted dog-fish lays its eggs in brown purse-like objects which are attached to seaweed. From April to June both male and female become very lively and swim about excitedly, the male biting his mate's fins and butting her with his nose and going through antics most extraordinary for a fish, as we see here. Photograph by F. Schensky of the Biological Station, Heligoland.

Chapter CXVI

Courtship Display in the Animal World

By R. I. Pocock, F.R.S.

Of the Zoological Department, British Museum

One of the first lessons in natural history the child learns is that male and female animals often differ in size, colour, voice and other particulars, and that the superiority in these respects is on the side of the male. He is taught to distinguish the lion from the lioness by his mane, the stag from the hind by his antlers, and the cock from the hen by his gaudy colouring and plumed tail, his crow and perhaps by the spurs on his legs.

These and many similar differences between the males and females of other beasts and birds are called secondary sexual characters; but although their origin and meaning have for many years been subjects for discussion amongst naturalists, there is still much to be learnt about them.

According to their functions most of these characters may be assigned to one of two categories. The first comprises organs, like horns, tusks and spurs, which have to do with the law of battle, with the contests between the males of a species for the possession of the females. The second comprises bright colours or plumes, sounding organs or odours, which are more directly concerned with courtship itself and apparently serve the purpose of stirring appropriate emotional responsiveness in the females at the breeding season

Since the subject of this chapter is the part played by plumes, colours and other garments in courtship, we must restrict our remarks mainly to those organs of the second category which were believed by Darwin to influence the female in the way described and to have been brought to their present state of perfection by the preference of the female, continued generation after generation, for the more gaudily attired males. Darwin, however, also thought it possible that horns and antlers of male antelopes and deer might be included in this category. But although these weapons admittedly add greatly to the handsomeness of the males from the human point of view, their function for their owners is now considered to be solely combative.

One little point about them must be referred to, nevertheless. It is not to the advantage of a species that an older and, for the time being, stronger male should kill his younger rival. Hence the antlers of deer carry accessory branches which act as guards against serious injury. It is well known in fact that fights between two stags seldom end fatally. Similarly, wild boars are provided with warts or shields of thick skin as a protection against the tusks of opponents. This suggests that the lion's mane, although enhancing the splendid appearance of the animal, is to be interpreted as a mat of hair guarding the neck and throat from the claws and teeth of a rival. At all events, there is no evidence that a lion displays his mane to the lioness or that a lioness in any way prefers a larger-maned to a smaller-maned lion as a mate.

The mane of the male hamadryas baboon possibly serves the same purpose as that suggested for the lion; but we do not know the meaning of many of the secondary sexual characters of mammals. The adult male mandrill, another species of baboon, is much more brilliantly tinted with red and blue on the face and other naked parts than the females or young males; the male nilgai antelope upon reaching maturity turns iron-grey, the females remaining tawny; and the male blackbuck assumes either seasonally or permanently a black coat, the female retaining through life the characteristic sandy tint of all the gazelles. But there is no display of these colours by the males; nor is there any justification for the belief that their development has been fostered by female preference.

It was facts of this nature that influenced Wallace, who, in opposition to Darwin, believed that in no class of animals has female choice exercised an influence upon the secondary sexual characters of males. He held that horns, manes, crests and plumes are indications of superior strength and vitality in virtue of which those males were more

W. S. Berridge

WEDDING GARMENT OF THE TAHR

When they go out to find a mate the male tahrs have their long, shaggy beards at their finest. During the summer the older males leave the females in their flocks and herd by themselves. We see one here in its shaggy wedding-garment.

G. Hearn

THE VIPER'S COURTSHIP

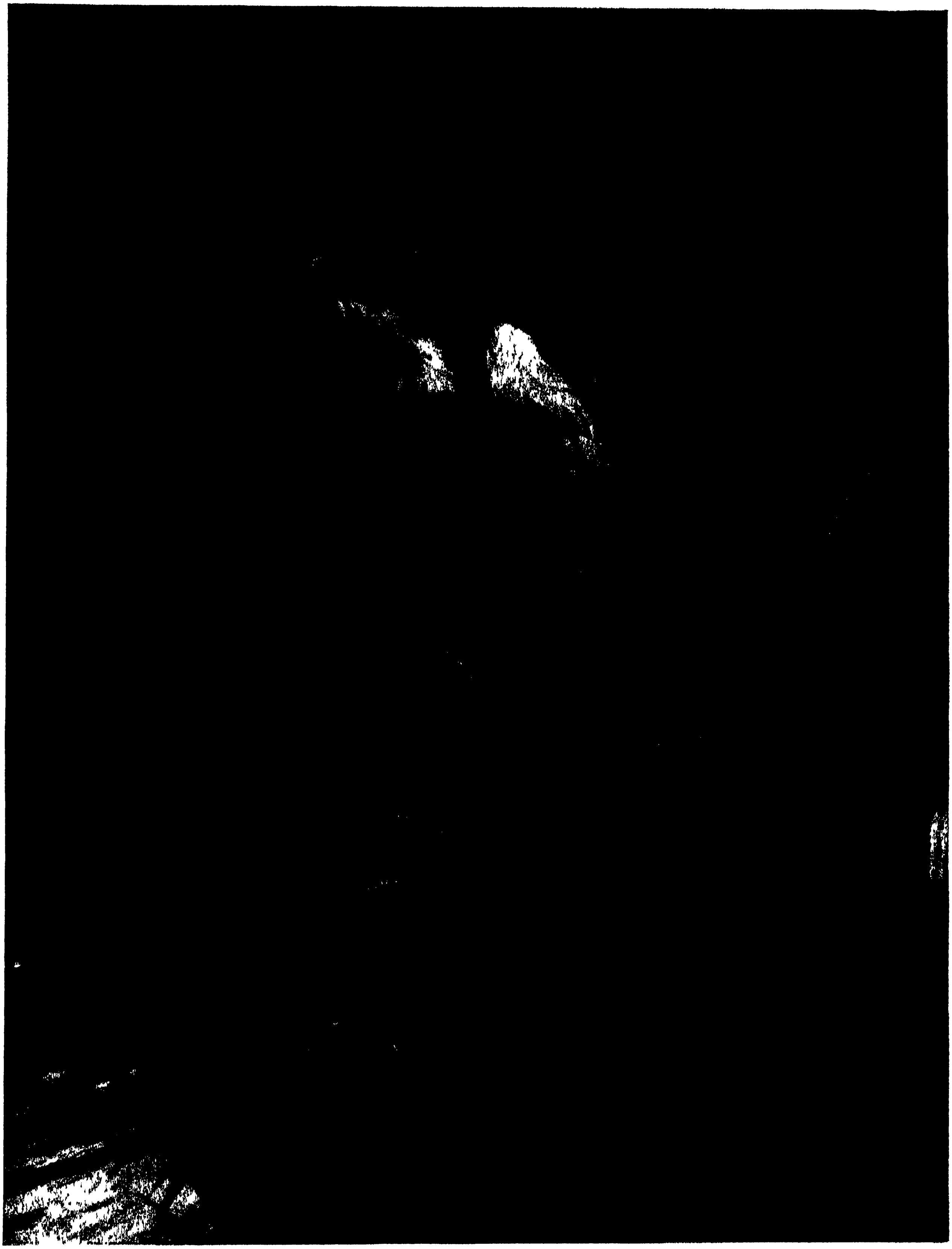
When vipers prepare to wed they find some quiet and sunny place where they can bask side by side (bottom). The pair then go through a number of evolutions, chasing and twisting round each other as we see in the upper photograph

successful in securing mates than their less favoured rivals, quite irrespective of female preference. He also thought that a tendency to produce bright colours and patterns is inherent in both sexes and that where the females differ from the males in that respect, as in the case of the wild duck in the winter and the pheasant throughout the year, the development of colour has been arrested by natural selection in the female to enable her to escape observation while nesting. General opinion, however, favours Darwin's view that the decorations of males are specialised developments; and in one species of bird, the ruff, as we shall show, recent observations attest preference on the part of the females for the finest males. Evidence on this head is, however, extremely scanty and nothing is more noticeable to those who watch the courtship of birds than the apparently complete indifference of the hens to the elaborate display of beauty presented to them by the cocks.

Neither of the theories above epitomised explains all the facts. Some still remain a puzzle awaiting solution; and of these none is perhaps more baffling than that presented by the immense horns on the head and thorax of the males of the great tropical beetles known as the hercules and atlas beetles. An interesting fact about these horns is that their size depends upon the size of the individuals that carry them, the dimensions increasing not in simple proportion, but in a rapidly increasing ratio; and this, we may add, is a very general rule with similar appendages throughout the animal kingdom, the proportionate weight of the appendage to that of the body being mathematically fixed, thus attesting the existence of a law of growth of which we do not know the explanation.

Now the function of the horns in the hercules and atlas beetles is quite unknown. They are not weapons for fighting—for, apart from their unsuitability for that purpose, the insects are not pugnacious—and they cannot be regarded as ornamental. Their arrangement and size suggest that they may be prehensile, possibly for holding the female; but they never show any signs of wear or use in any way, and we must leave them at that. On the other hand, the horns of the male stag beetle, which are enlarged jaws, serve the double purpose of grasping the female and of fighting with rival males, thus coming in this respect into the same category as the antlers of deer, which they resemble.

The marked difference between the males and the females of the beetles quoted shows that secondary sexual characters may be as highly developed in some classes of invertebrate animals as in beasts and birds; but only in one group of invertebrates, apparently, have we positive evidence of display of bright colours and ornamental tufts by the males to the females such as occurs in birds. This group is that of the spiders. There is a large family of spiders, called the Attidae, remarkable for the possession of a pair of immense eyes occupying almost the whole area of the face. They stealthily stalk flies and catch them with a leap, a proceeding demanding keenness and precision of vision found in no other families of this order.



THE KINGFISHER GOES COURTING IN A LIVERY OF BRILLIANT COLOURS

When the time comes for pairing the kingfisher's gorgeous plumage is seen at its best as the bird flashes over stream or lake. The female can be distinguished by the duller and greener feathers while the immature birds which have not yet reached the age to go courting, are of a browner tone. Besides its bright back and wing feathers, the kingfisher sports a jaunty moustache at the base of its beak.

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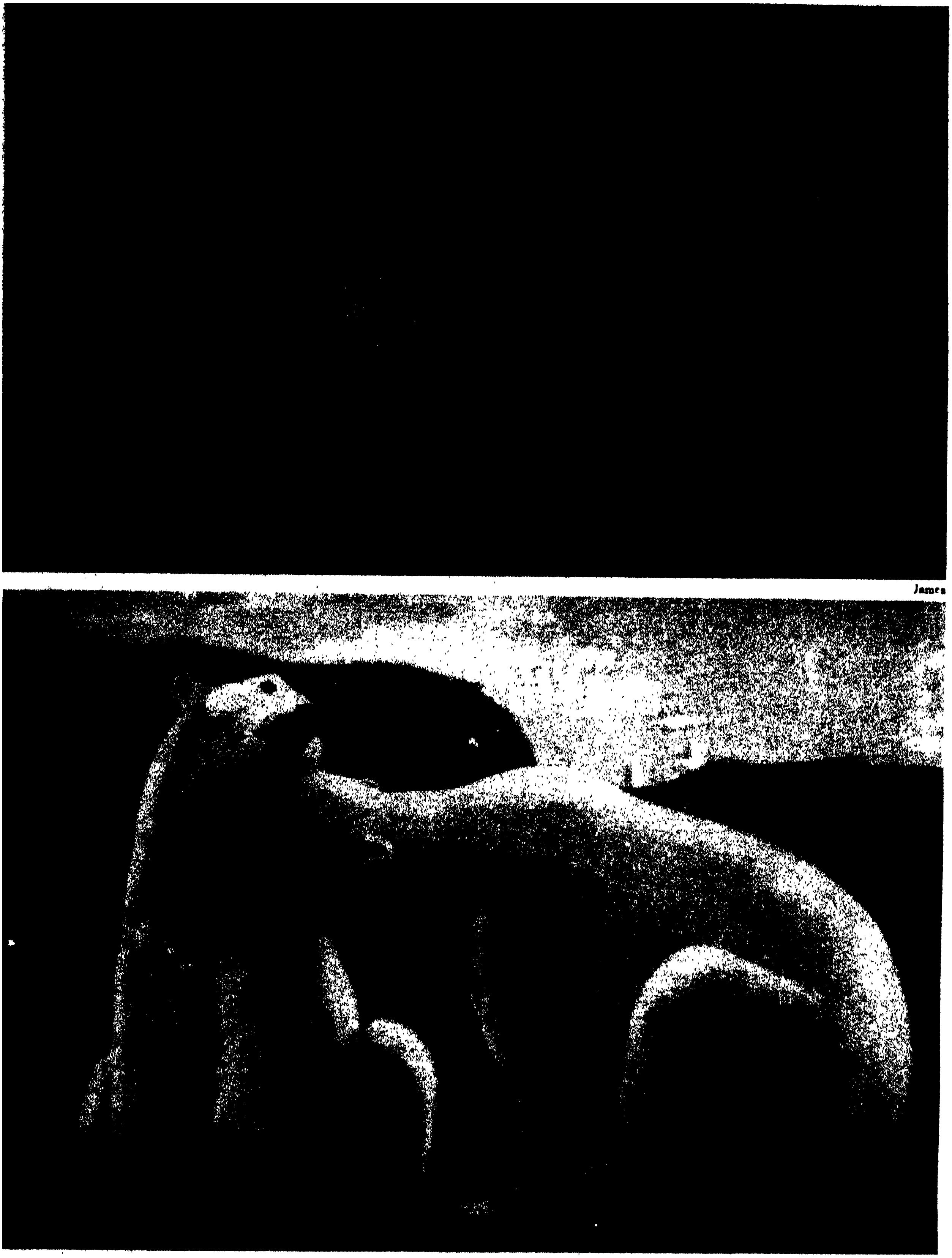


James

POLAR BEARS AND CATTLE DISPLAY AFFECTION BEFORE MATING

Most of the higher animals go through some sort of courting ritual though in some it seems to be merely a question of forceful capture. Polar bears, however, display great affection, playing together and suffering the usual foolishness characteristic of courtship. The upper photograph shows a bull and a cow of a breed of English park cattle. Preliminaries for mating consist of mutual, though gentle, buttings and rubbings of nose against nose. Often the cow makes most of the advances.

E N A

The males of many of these spiders differ strikingly from the females in the gaudy colouring of the fore parts of the body and limbs, and, when courting the female, the male performs fantastic antics in front of her, unmistakably displaying his beauty by presenting to her view only those parts which are specially decorated. It is true that there is no proof that the female prefers the most gaudily attired of her suitors, but it is impossible to doubt that the display has some effect upon her choice, and it is particularly significant that this display is practised only by spiders with well-developed visual powers capable of seeing clearly the decorations.

The sexes also differ in colour in some insects. As instances may be cited the common orange-tip butterfly, so called from the presence of a conspicuous orange patch on the wing of the male which is absent in the female, and the chalk-hill blue in which the wings are azure blue in the male and brown in the female. Since butterflies are known to have good vision, capable of distinguishing flowers from foliage, it may well be that the females of these species, by preferring to mate with males showing orange or azure tints, have by a long process of selection brought about the marked differences by which the sexes can be distinguished at a glance.

E N A

MAN-OF-WAR AND FRIGATE BIRDS

Frigate birds in mating time are most entertaining to watch. The male searches about until he has found a good nesting site and then sits upon it and inflates a skin pouch under the beak. It looks like a blood-red balloon and the bird agitates it, to and fro, till some female arrives to make him happy. Below are man-of-war birds courting.

TURNING to the vertebrate animals, the mammals have already been dealt with, and call for no further mention, because there is no evidence that the males of any species, even when differently coloured from the females, make any attempt at display. This is somewhat surprising, seeing that the mammals are usually considered to be the most highly organized class of this sub-kingdom.

In the most lowly organized class, the fishes, on the other hand, there are reasons for thinking that the males of some kinds display special colours and ornaments before the females. Even in such species as the common tench and roach the colours of the male become intensified at the breeding season, and in a Chinese fish (*Macropus*) the male is not only more brilliantly tinted than the female, but during courtship expands his brightly-coloured fins and leaps about with great vivacity.

Still more significant is the case of the sword-bearer (*Xiphophorus*), in which the lower edge of the tail-fin in the male is developed into a long, brightly striped filament; and since this is not provided with muscles, and is therefore useless for swimming, it is regarded as purely ornamental. Also, the male dragonet (*Callionymus*) differs from the female not only in being more brilliantly striped and spotted with vivid blue on the head, but has the dorsal fin extraordinarily elongated. These special growths and brighter tints, accompanied by active movements on the part of the males in the presence of the females at spawning time, favour the view that they have been developed by female preference.

The class above the fishes, the amphibia, presents an analogous case in the newts, common in ponds, where they breed, in the spring and summer. The males at those seasons become more brilliantly yellow below, and acquire a soft, erect crest along the back and tail which disappears during the winter.

W S Berridge

H Bastin

BIRD OF PARADISE AND THE OSTRICH'S PROPOSAL

The head ornament of the Superb bird of paradise (bottom) is of an extraordinary shape. The birds of paradise are famous, but this particular kind is prominent even in such company The upper photograph shows a cock ostrich displaying before the hen

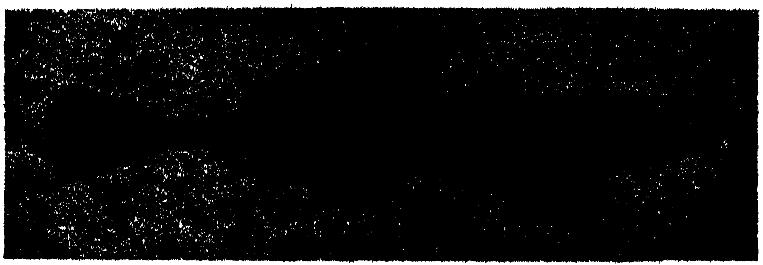
In the higher class, the reptiles, we also meet with somewhat similar but persistent dorsal crests in the males of some lizards, whereas in others the males are provided with a brightly-coloured dilatable throat-pouch which is expanded and exhibited only during the breeding season.

But it is in birds, the courtship of which has been more closely observed than in other animals, that we find the greatest evidence in favour of Darwin's hypothesis. Whether the sexes are alike or different in colour, they behave towards one another at the breeding season in a variety of ways which appeal to the senses of hearing, touch or sight. In guillemots, for example, in which the sexes are alike, the pair interlock their necks and bills, nibble each other, bow and wag their heads, and sway their bodies from side to side. In this instance, as in that of the great crested grebe, where again the sexes are alike, the courtship is mutual, both male and female going through a remarkable sequence of actions. But when the sexes differ considerably in colour and adornment, as in the ostrich, peacock, birds of paradise and many others, the courtship display is practised by the cock, the part played by the hen being passive. Each type of bird has its own method, and it is only possible to mention one or two in detail.

The male ostrich, which differs from the greyish-brown hen in being black-and-white, goes through a remarkable performance. Taking a position facing the hen, he drops on his hocks in a squatting attitude, spreads his wings, lowers his tail, and throwing his neck over his back, sways slowly and rhythmically from side to side, swinging his neck to right and left and often setting his wings ashake. This may go on for ten or more minutes. Then, suddenly rising to his feet, the cock rushes towards the hen with wings outspread and sometimes repeats the performance at close quarters, sometimes bringing it to a close by stamping on the ground like a soldier rapidly marking time. The hen, on the contrary, does not pay the slightest attention to his antics, but treats him and his behaviour with the most supreme indifference.

The beauty and display of the peacock are familiar to all. The full-grown bird has a brilliant bluish-green throat and breast and develops for the courting season a train of immensely long feathers, each adorned at the tip with the well-known "eye-mark"; and this train, generally but wrongly called the tail, is raised during display and spread like a great fan, the true tail, which is beneath, being raised and spread at the same time to support it. With the train thus spread, the wings drooped and the

indications of exuberant vitality. No two ruffs are alike in colour; each, however, acquires for the breeding season a great fan of feathers on the sides of the neck—whence the name. But they vary in decorativeness, and it is only the fully adorned ruffs that come to the fore on the courting-ground, the shabbier individuals keeping disconsolately in the rear and remaining completely unnoticed by the reeves, or females



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DRAGONETS THAT HAVE ELABORATE COURTSHIPS

So brightly coloured are the male dragonets that one could think they came from the tropic seas. Here we have a female (bottom) and a male (top). But most species live in the north temperate zone. These fish are very active at mating time and the males have brilliant markings and long, projecting filaments on the fins.

beautiful neck to the fore, the bird presents the most gorgeous and striking appearance as he faces the hen; but she, as in the case of the hen ostrich, is apparently quite unimpressed by the splendid spectacle.

The turkey cock is particularly interesting when studied in connection with the peacock, because the attitude of the two assumed in display is the same. In detail the display is different because the adornment of the turkey's neck is due to the brilliant colouring of the naked skin and there is no resplendent train to be lifted by the upraised expanded tail; but no one who compares the two birds while courting can doubt that the display of the turkey represents an early phase in the display of the ancestors of the peacock, before the wonderful train was developed.

The cock Argus pheasant excels even the peacock in feather development, although not in brilliance of tint. He also faces the hen during courtship; but other pheasants behave differently. They run in half-circles in front of the hens, so as to display at a time the beauty of only one side of the body.

Equally varied and elaborate are the attitudes assumed by cock birds of paradise, which are most beautifully decorated with coloured plumes, iridescent patches and other ornaments; and even the tiniest of all birds, the humming birds, which rival the birds of paradise in their gorgeous apparel, go through the most intricate manoeuvres to display their beauty to the females when courting them.

THE last case we have space to allude to is that of the ruff, a polygamous plover; but it is particularly important in supplying evidence, as shown by Mr. E. Selous, of preferential mating on the part of the female, or reeve, as she is called. This plover has several scientific names, such as *Machetes* and *Philomachus*, based upon the seemingly desperate combats in which the males, or ruffs, indulge; but these fights are harmless affairs and, like the other antics practised, such as frantically darting about, leaping, kicking, whirring the wings and so forth, are merely

There is one other aspect of sexual display to be considered. Since in the case of the spiders no one probably will dispute that the behaviour of the males during courtship is purely instinctive and not prompted by a knowledge of their beauty, we are led to inquire if the same is not true of birds. There are many facts supporting this conclusion. In the first place cock birds in full feather will not uncommonly go through all the phases of display characteristic of the species when hens are nowhere at hand. Sometimes they display to one another, sometimes to nothing at all. Taking the peacock as a type, these birds have been seen to show off in the presence of sparrows and to an old felt hat on the ground. Again, most birds in which the two sexes are alike behave in the breeding season in a way that would be called display if they possessed any special ornamentation to show. These facts seem to suggest very forcibly that the strange behaviour of birds during courtship is instinctive, is the outcome of the physiological disturbance that affects their entire organization when the breeding fever holds sway.

In describing the display of cock birds most naturalists write under the belief that they assume particular attitudes for the purpose of showing off their colours or plumes. In other words, the birds display because they are decorated. But we shall probably be nearer the truth if we invert the idea and say that decorations are developed on particular areas because the cocks pose in a particular manner. The decorations, that is, are adapted to the display.

END OF THIRD VOLUME